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PROGRESS REPORT 3

GEOTECHNICAL DATA GATHERING PROJECT

GEOLOGIC PROGRAM

SECTION 1.1

TO

AREA OIL SHALE SUPERVISOR
UNITED STATES GEOLOGICAL SURVEY

By

RIO BLANCO OIL SHALE PROJECT
Gulf Oil Corporation
and
Standard Oil Company (Indiana)

July 15, 1975

TABLE OF CONTENTS

	SECTION NUMBER
GEOTECHNICAL DATA GATHERING PROJECT	1.0
Geologic Program	1.1
Corehole Program	1.1.1
Laboratory Analyses	1.1.2
Stratigraphic Compilation	1.1.3
Aerial Photography	1.1.4
Compilation of Topographic Maps	1.1.5
Photogeologic Mapping	1.1.6
Surface Geologic Mapping	1.1.7
Seismic Program	1.1.8
Structural Compilation	1.1.9

SECTION 1.0

1.0 GEOTECHNICAL DATA GATHERING PROJECT

The data obtained from the geotechnical data gathering project during the third quarterly reporting period are submitted with this progress report. Major tasks of the geologic program have essentially been completed and reported prior to the third quarterly reporting period. The data from the upper and lower pump testing task and data from the alluvial aquifer and deep aquifer monitoring tasks of the hydrologic program are incorporated in this progress report as reported in RBOSP Progress Report 2. Much of the data from those tasks has either been recently generated or was used during the pump testing program and could not be correlated until the pump testing was completed. Data for the Hydrologic Program, Section 1.2, are submitted in two parts. One part is the text portion and provides an explanation or interpretation of the data submitted. The other part contains the raw data in computer printout form. The original computer printouts have been reduced for ease in handling.

1.1 Geologic Program

Most of the tasks conducted under the geologic program are essentially complete. The following sections update the status of each of the tasks or submitted appropriate data.

1.1.1 Corehole Program

The corehole program is complete as reported in Rio Blanco Oil Shale Progress Report 2 - Summary.

1.1.2 Laboratory Analyses

The laboratory analyses for oil shale grade, nahcolite, extractable alumina, and trace elements have been submitted to the Area Oil Shale Supervisor as reported in RBOSP Progress Report 2. The Colorado School of Mines in conjunction with Core Laboratories, Inc. conducted the mineral identification and qualitative analyses for the occurrence of seven trace elements (cadmium, antimony, arsenic, mercury, selenium, fluide ion, and boron) as required by the oil shale lease. The results of this analysis are submitted to the Area Oil Shale Supervisor in this section of RBOSP Progress Report 3.

Rec 3-10-75

CORE LABORATORIES, INC.
Petroleum Reservoir Engineering
DALLAS, TEXAS 75247

REPLY TO:
BOX 731
CASPER, WYOMING 82601

March 7, 1975

Mr. E. A. Ziemba
Rio Blanco Project
Dayton Commons
9725 E. Hampden Avenue
Denver, Colorado 80231

Dear Mr. Ziemba:

Enclosed are copies of the report on mineral identification and trace element correlations as presented to us. The tabular and graphic data are preceded by a brief discussion and explanation of the pertinent theoretical aspects of this work.

The report contains data for core hole 2-3 and core hole 7 only. If you wish furthur work done on these two core holes, such as the quantitative mineral analyses suggested in the report, or if you want analyses on other holes please let us know. Also, if there is anything we can do to facilitate your interpretation of this report please feel free to give us a call.

Very truly yours,
CORE LABORATORIES, INC.

Arthur P. Hoeft
Laboratory Supervisor
Coal, Water & Mineral Lab

APH/ddc
enclosures

FEASIBILITY STUDY
OF MINERAL ANALYSIS AND
TRACE ELEMENT PARTITIONING
IN OIL SHALES

February 28, 1975

Purpose

To test feasibility and develop methods for quantitative mineral analysis and partitioning of selected trace elements among mineral species of 97 core samples of the Green River Formation.

Procedures

All samples were re-ground to 325 mesh. We prepared bulk mounts of all samples for x-ray diffraction analysis. We prepared oriented mounts from slurries of selected samples of the bulk material for diffraction analysis of clays. From selected samples we also separated clay material by settling and prepared oriented diffraction mounts.

We analyzed each sample by x-ray diffraction, identified all minerals and determined variations in the sample suite. Relative x-ray intensities were plotted to determine trends and variations.

Once sure from qualitative x-ray analyses that we could do quantitative x-ray analysis, we generated and tested quantitative analysis procedures for future samples. The procedures developed will give complete quantitative mineral analyses except perhaps for mineral species such as nahcolite which may be destroyed during sample preparation. We are continuing to investigate analysis of these fragile minerals.

We determined and tested an element partitioning method usable for composite oil shale samples. When refined and combined with quantitative mineral analyses this method should give fairly good partitioning of trace elements among mineral species in parts per million.

Briefly part of the partitioning method is as follows:

$$\frac{\left| a \frac{dm_i}{dz} - \frac{de_j}{dz} \right|}{\left| a \frac{dm_i}{dz} \right|} = R_{ij} , \qquad (1)$$

where

R_{ij} is an agreement index between i th mineral and the j th element,

m_i = fraction of the maximum (or mean) amount of a mineral i found in the core,

e_j = fraction of the maximum (or mean) amount of a trace element j in the core,

a is a scaling constant and

z is distance down the core hole.

The smaller the value of R the better the correlation.

$$w_{ij} = (1 - b_{ij} R_{ij}), \qquad (2)$$

where $b_{ij} = \sum_i 1/R_{ij}$.

The value w_{ij} is the weighting or distribution coefficient for the j the element in mineral i.

The weighting coefficient gives the relative amounts of trace elements in a mineral species in the sample. Knowing the percentage of each species the concentration per species can be calculated. We did not do these last calculations since we did not have the amount of each species.

Results

In the following pages we present tables of the weighting function w_{ij} X 10 listed from top of hole downward. The weighting functions are done manually and with some shortcuts in the calculations; therefore, they are approximate. We have applied only one crystal-chemical rule to exclude an element: We did not permit cadminum in quartz. When interpreting weighting factors remember that a weighting factor of 1 may give a higher concentration in a mineral if it is present at the 1% level than a weighting factor of 5 or 6 for a mineral at the 50% level. Note that the table values generally do not show values below one even though w_{ij} usually will not be zero. We have simply not allowed low weights to appear, all elements being assigned to minerals with higher weights. On future samples all samples will be assigned weights by computer analysis.

Following the tables of weighting factors for each hole are plots of relative diffraction intensities of mineral species and amounts of trace elements of fresh and spent samples plotted consecutively down the hole. Our results appear reasonable and a literature search confirmed the reasonability of the element partitioning both on theoretical and experimental considerations.

Note that on the tables feldspar is listed as andesine.

We found poor correlation between dawsonite in the spent shale and amount of acid-extractable alumina in the spent shale. We did find good correlation between amount of dawsonite in the fresh shale and amount of acid-extractable alumina in the spent shale. Dawsonite shows a marked decrease from fresh to spent shale. Conclusion: The structure of dawsonite is being destroyed by the oil extraction process. We did not include acid-extractable Al_2O_3 partitioning in the result tables.

We have found in general that the samples of fresh and spent shales were well mixed and split. However in a few samples both mineral and trace element analyses indicate that better mixing and splitting of the composite samples would improve correlations between fresh and spent shales.

Conclusion

We think we can partition the trace elements. We must do quantitative analysis to accomplish the task. We must also program the calculations and plots. Quantitative analysis is feasible and we have set up and tested the procedure. We have also defined the programming for partitioning the elements.

Future samples

Should you want to continue with the analyses in the number of samples suggested to us, we will do all analyses quantitatively. As you know we have a special system here for quantitative analysis of minerals in shales. We will also rerun initial samples quantitatively at $15.00 per sample. We will partition the elements in all samples and present quantitative plots of concentrations for each mineral as well as plots and lists of amounts of each mineral and element. We shall also address ourselves to the determination of the fragile mineral fraction such as nahcolite, etc.

Apology

We apologize for the lack of neatness of the report. We spent so much time finding out what we were doing and preparing the necessary computer and x-ray methods we did not have time for neat drafting of this preliminary research.

Sample Identification Key

In the following tables the samples are identified only by laboratory control number. These control numbers are the same as those used on the analytical reports of trace element concentrations. For convenience they are listed below.

Core Hole	Depth	Lab Number	Core Hole	Depth	Lab Number
2-3	0-70	1	7	11-40	26
	70-130	2		40-86	27
	130-174	3		86-112	28
	174-240	4		112-156	29
	240-278	5		156-204	30
	278-350	6		204-222	31
	350-406	7		222-294	32
	406-426	8		294-358	33
	426-487	9		358-440	34
	487-560	10		440-528	35
	560-640	11		528-604	36
	640-740	12		604-647	37
	740-834	13		647-739	38
	834-860	14		739-772	39
	860-920	15		772-846	40
	920-970	16		846-888	41
	970-994	17		888-950	42
	994-1086	18		950-975	43
	1086-1116	19		975-1062	44
	1116-1172	20		1062-1100	45
	1172-1206	21		1100-1153	46
	1206-1280	22			
	1280-1308	23			
	1308-1360	24			

Cadmium 1-25 Fresh

	Quartz	Dolomite	Calcite	Analcime	Andescine	Illite	Dawsonite	Pyrite
	-	4	-	-	-	-	1	5
2.	-	1	2	3	-	1	-	3
3.	-	2	2	-	-	3	-	3
4.	-	-	-	-	-	-	5	5
5.	-	3	2	-	1	3	1	-
6.	-	1	2	2	-	-	2	3
7.	-	-	7	3	-	-	-	-
8.	-	-	3	7	-	-	-	-
9.	-	-	-	5	-	-	5	-
10.	-	-	3.3	3.3	-	-	3.3	-
11.	no correlation possible							
12.	-	3	3	-	.5	.5	-	3
13.	-	-	-	5	-	-	5	-
14.	no correlation possible							
15.	-	3	-	1	-	6	-	-
16.	-	-	1	-	3	-	3	3
17.	-	3	3	-	-	-	-	4
18.	-	3	-	-	2	-	5	-
19.	-	1.5	-	1.5	1	-	3	3
20.	-	2.5	-	2.5	1	-	4	-
21.	-	3	-	-	2	-	5	-
22.	no correlation possible							
23.	-	1	-	-	-	3	6	-
24.	-	2.5	-	-	-	2.5	4	-

Cadmium 2-25 Spent

2.	-	3	4	-	-	3	-	-
3.	-	1	3	2	-	2	2	-
4.	-	3	-	-	3	-	4	-
5.	-	-	-	3	-	-	4	3
6.	-	4	-	2.5	-	-	2.5	1
7.	-	4	2	-	-	-	2	2
8.	-	-	-	-	3	1	3	3
9.	-	1	2	4	-	-	1	1
10.	-	-	3	2	2	-	3	-
11.	-	-	-	1.5	1.5	-	7	-
12.	-	3	3	-	2	-	-	2
13.	-	4	-	-	-	-	2	4
14.	-	-	.5	3	3	3	.5	-
15.	-	3	1	-	-	3	1	2
16.	-	4	2	2	-	-	-	2
17.	-	2	3	-	-	-	-	5
18.	-	-	5	-	-	-	-	5
19.	-	-	-	1	1	5	-	3
20.	-	5	-	5	-	-	-	-
21.	-	2	-	4	-	-	-	4
22.	-	4	-	-	-	-	-	6
23.	-	2	-	2	-	2	-	4
24.	-	-	-	2	3	-	3	2

Arsenic 1-25 Fresh

	Quartz	Dolomite	Calcite	Analcime	Andescine	Illite	Dawsonite	Pyrite
1.	-	3	-	-	-	-	5	2
2.	4	-	-	-	3	-	3	-
3.	-	2	1	-	-	4	-	3
4.	-	-	-	-	-	-	4	6
5.	1	3	1	-	1	3	1	-
6.	1	1	1	2	-	-	2	3
7.	4	-	2	4	-	-	-	-
8.	-	1	-	-	4	4	1	-
9.	2	-	-	4	-	-	4	-
10.	1	-	1	5	-	-	3	-
11.	3	2	-	-	-	2	3	-
12.	2	-	-	2	-	-	6	-
13.	2	-	-	4	-	-	4	-
14.	10	-	-	-	-	-	-	-
15.	1	-	1	-	4	-	3	1
16.	2	-	2	-	2	-	2	2
17.	-	2	2	-	-	-	-	6
18.	1	-	2	2	-	1	-	4
19.	-	-	6	-	-	4	-	-
20.	1	1	-	1	1	-	1	5
21.	2	3	-	-	2	-	3	-
22.	-	4	-	-	2	-	4	-
23.	-	3	-	-	-	3	4	-
24.	2	2	-	-	-	2	4	-

Arsenic 2-25 Spent

2.	1	-	-	2	2	-	2	3
3.	1.5	2	-	1.5	2	1.5	1.5	1
4.	-	3	-	-	4	-	3	-
5.	1	-	1	3	-	-	3	2
6.	-	-	1	-	7	1	-	1
7.	-	-	-	3	3	3	-	1
8.	2	2	3	3	-	-	-	-
9.	-	-	-	1	3	5	1	-
10.	-	-	2	2	2	1	3	-
11.	-	3	2	4	-	-	2	-
12.	1	-	1	2	1	2	3	-
13.	-	-	2	4	2	2	-	-
14.	2	-	3	1	1	1	2	-
15.	1	3	-	1	-	1	3	1
16.	-	-	-	-	2	3	5	-
17.	1	-	-	1	1	3	4	-
18.	1	1	-	1	3	1	3	-
19.	1	2	2	2	2	-	1	-
20.	1	-	1	-	2	-	-	6
21.	1	1	-	3	-	-	-	5
22.	2	2	-	-	-	-	-	6
23.	2	-	4	-	3	-	1	-
24.	-	-	-	1	3	-	5	1

Antimony 1-25 Fresh

	Quartz	Dolomite	Calcite	Analcime	Andescine	Illite	Dawsonite	Pyrite
1.	-	3	-	-	-	-	5	2
2.	no correlation possible							
3.	-	4	1	-	-	3	-	2
4.	1	3	1	3	1	1	-	-
5.	1	3	2	-	1	1	2	-
6.	2	1	3	2	-	-	1	1
7.	5	-	3	2	-	-	-	-
8.	no correlation possible							
9.	5	-	-	2.5	-	-	2.5	-
10.	4	-	3	1	-	-	2	-
11.	-	-	4	4	1	-	-	1
12.	4	-	-	5	-	-	1	-
13.	1	-	-	5	-	-	4	-
14.	4	-	1	2	-	1	2	-
15.	-	5	-	1	-	4	-	-
16.	2	-	2	-	2	-	1	3
17.	1	3	1	1	1	1	1	1
18.	5	-	1	3	-	-	-	1
19.	1	-	6	-	-	3	-	-
20.	2	2	-	2	3	-	1	-
21.	2	3	-	-	2	-	3	-
22.	-	3.5	-	-	3	-	3.5	-
23.	-	4	-	-	-	4	2	-
24.	2	3	-	-	-	4	1	-

Antimony 2-25 Spent

2.	2	-	-	2	3	-	3	-
3.	1	2	-	-	3	-	-	4
4.	2	-	2	3	-	1	-	2
5.	-	-	-	3	-	-	2	5
6.	-	1	2	-	5	2	-	-
7.	-	-	-	3	3	2	-	2
8.	-	-	-	-	2	4	-	3
9.	-	-	-	1	4	5	-	-
10.	-	-	2	3	3	-	2	-
11.	-	2	-	3	-	-	1	4
12.	1	-	1	3	1	1	3	-
13.	-	-	2	3	2	3	-	-
14.	4	-	3	-	-	-	3	-
15.	-	3	1	-	-	1	5	-
16.	no correlation possible							
17.	2	-	-	-	3	-	4	-
18.	2	-	-	-	5	-	-	3
19.	2	-	-	-	-	5	-	3
20.	2	4	-	4	-	-	-	-
21.	3	1	-	4	-	-	-	2
22.	3	3	-	-	-	-	-	4
23.	-	3	-	1	-	2	-	4
24.	-	-	-	2	3	-	3	2

Mercury 1-25 Fresh

	Quartz	Dolomite	Calcite	Analcime	Andescine	Illite	Dawsonite	Pyrite
.	-	3	-	-	-	-	5	2
2.	-	1	3	2	-	1	-	3
3.	-	2	4	-	-	2	-	2
4.	-	-	-	-	-	-	4	6
5.	-	-	-	6	-	-	-	4
6.	-	-	-	-	10	-	-	-
7.	-	1	-	-	1	3	2	3
8.	-	3	-	-	1	1	5	-
9.	-	2	3	-	-	3	-	2
10.	1	-	4	1	-	-	4	-
11.	1	3	-	-	-	3	3	-
12.	-	3	3	-	.5	.5	-	3
13.	2	-	-	4	-	-	4	-
14.	1	-	3	3	-	-	3	-
15.	1	3	1	2	1	-	1	1
16.	1	-	3	-	2	-	2	2
17.	2	-	-	2	3	-	3	-
18.	-	4	-	-	4	-	2	-
19.	-	2	-	3	3	-	1	1
20.	2	2	-	2	1	-	3	-
21.	2	2	-	-	2	-	4	-
22.	-	3	-	-	3	-	4	-
23.	-	3	-	-	-	3	4	-
24.	1	2	-	-	-	2	5	-

.4.

Mercury 2-25 Spent

2.	-	2	3	-	-	4	-	-
3.	-	-	7	1	-	1	1	-
4.	-	4	-	-	3	-	3	-
5.	-	-	-	4	-	-	2	4
6.	2	1	-	2	-	-	3	2
7.	-	-	-	3	3	3	-	1
8.	1	1	3	4	-	-	1	-
9.	-	-	-	-	5	4	1	-
10.	-	-	1	4	3	-	2	-
11.	5	-	-	2	-	-	4	-
12.	-	7	1	-	1	-	-	1
13.	2	-	2	-	2	-	4	-
14.	4	-	2	-	-	-	4	-
15.	1	-	2	1	4	1	-	1
16.	3	5	-	1	-	-	-	1
17.	-	2	4	-	-	-	-	4
18.	-	-	5	-	-	-	-	5
19.	1	-	-	-	-	6	-	3
20.	2	4	-	3	-	-	-	1
21.	1	1	-	4	-	-	-	4
22.	2	2	-	-	-	-	-	6
23.	-	2	-	2	-	3	-	3
24.	1	3	2	-	-	3	-	1

Fluoride 1-25 Fresh

	Quartz	Dolomite	Calcite	Analcime	Andescine	Illite	Dawsonite	Pyrite
1.	-	4	-	-	-	-	4	2
2.	3	-	-	-	3	-	4	-
3.	-	2	3	-	-	2	-	3
4.	-	-	-	-	-	-	4	6
5.	1	2	1	-	1	3	2	-
6.	1	1	1	2	-	-	1	4
7.	-	1	-	-	2	3	1	3
8.	-	1	-	-	4	4	1	-
9.	2	-	-	4	-	-	4	-
10.	-	2	-	-	2	3	-	3
11.	-	-	3	3	2	-	-	2
12.	-	2	3	-	1	1	-	3
13.	-	3	1	-	1	3	-	2
14.	-	2	1	-	2	2	1	2
15.	2	-	2	-	2	-	2	2
16.	2	-	2	-	2	-	2	2
17.	2	-	-	2	3	-	3	-
18.	3	-	2	2	-	1	-	2
19.	2	2	-	2	2	-	1	1
20.	2	2	-	2	2	-	2	-
21.	2	3	-	-	2	-	3	-
22.	3	-	3	-	-	4	-	-
23.	3	-	3	-	4	-	-	-
24.	-	-	2	3	5	-	-	-

Fluoride 2-25 Spent

2.	3	-	-	2	2	-	2	1
3.	-	-	4	2	-	2	2	-
4.	-	4	-	-	2	-	4	-
5.	-	-	-	3	-	-	3	4
6.	2	2	-	2	-	-	2	2
7.	3	2	2	-	-	-	3	-
8.	2	2	3	3	-	-	-	-
9.	-	-	-	-	5	5	-	-
10.	2	3	-	-	-	-	-	5
11.	-	1	2	-	3	4	-	-
12.	-	5	1	-	2	-	-	2
13.	2	4	-	-	-	-	-	4
14.	-	4	-	1	-	1	-	4
15.	1	1	1	1	4	1	-	1
16.	-	-	-	-	2	4	4	-
17.	-	2	5	-	-	-	-	3
18.	1	2	-	2	1	2	2	-
19.	1	2	1	-	-	4	-	2
20.	2	5	-	3	-	-	-	-
21.	3	2	-	3	-	-	-	2
22.	-	-	2	1	2	4	1	-
23.	2	-	4	1	2	-	1	-
24.	2	3	3	-	-	2	-	-

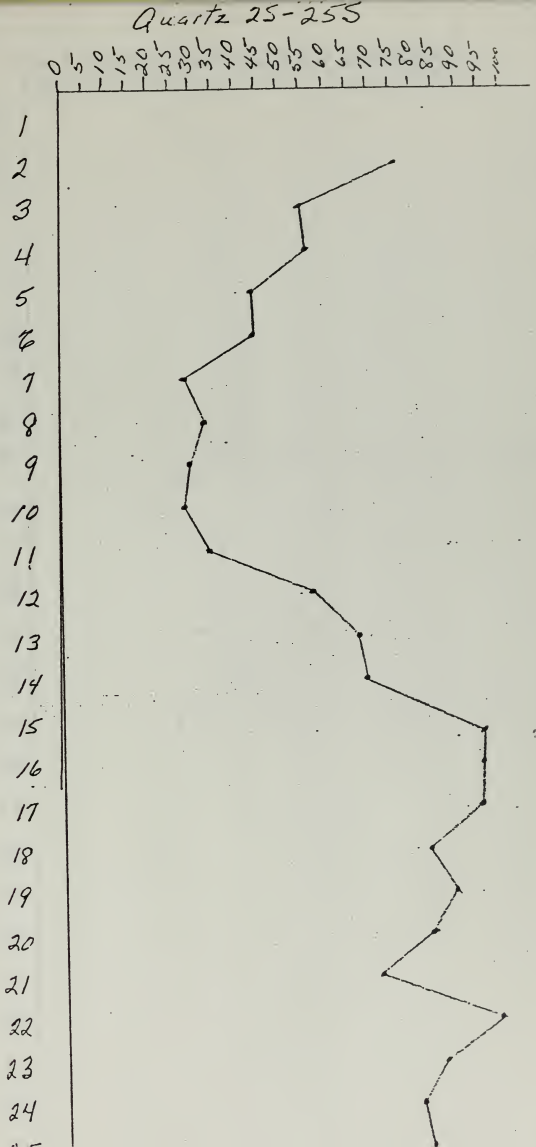
Boron 1-25 Fresh

	Quartz	Dolomite	Calcite	Analcime	Andescine	Illite	Dawsonite	Pyrite
1.	2	-	2	2	3	1	-	-
2.	-	2	2	2	-	2	-	2
3.	2	-	-	3	4	-	1	-
4.	-	-	-	-	-	-	4	6
5.	-	-	-	6	-	-	-	4
6.	-	-	-	-	10	-	-	-
7.	4	-	2	4	-	-	-	-
8.	-	2	-	-	3	3	2	-
9.	2	-	-	4	-	-	4	-
10.	2	-	2	4	-	-	2	-
11.	-	-	3	3	3	-	-	1
12.	-	3	3	-	.5	.5	-	3
13.	-	2	1	-	3	2	-	2
14.	-	1	2	-	1	2	3	1
15.	-	4	-	-	-	6	-	-
16.	-	6	-	1	2	1	-	-
17.	2	-	1	2	2	1	2	-
18.	1	-	1	1	-	5	-	2
19.	-	-	4	-	-	6	-	-
20.	-	-	4	-	-	6	-	-
21.	-	-	2	2	-	3	-	3
22.	3	-	2	-	-	5	-	-
23.	3	-	2	-	5	-	-	-
24.	2	2	-	-	-	2	4	-

Boron 2-25 Spent

2.	no correlation possible							
3.	2	1	-	2	1	2	2	-
4.	-	4	-	-	2	-	4	-
5.	-	3	1	-	3	3	-	-
6.	-	1	2	-	5	2	-	-
7.	-	-	-	3	3	3	-	1
8.	3	2	3	2	-	-	-	-
9.	-	-	-	-	3	5	-	2
10.	3	3	-	-	-	1	-	3
11.	-	2	2	-	3	3	-	-
12.	-	5	2	-	2	-	-	1
13.	3	-	2	-	2	-	3	-
14.	-	-	-	3	3	3	1	-
15.	1	-	2	2	1	3	-	1
16.	-	-	-	-	2	4	4	-
17.	1	-	-	1	1	3	4	-
18.	3	-	-	-	3	1	-	3
19.	1	-	-	-	-	7	-	2
20	-	-	2	-	2	4	2	-
21.	-	-	3	-	3	1	3	-
22.	-	-	2	3	2	-	3	-
23.	2	-	4	-	4	2	-	-
24.	-	-	-	3	3	-	5	-

Quartz 1F to 25-F


Quartz 25-255
0
5
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15
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25
30
35
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45
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60
65
70
75
80
85
90
95
100
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24

0 5 10 15 20 25 30 35 40 45 50 55 60 65 70 75 80 85 90 95 100
1
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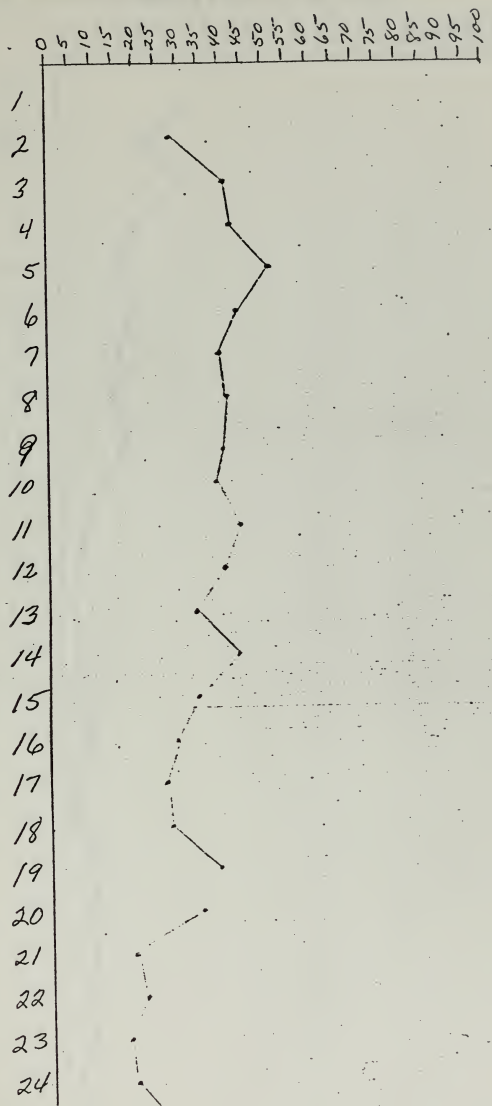
0
5
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40
45
50
55
60
65
70
75
80
85
90
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100
1
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21
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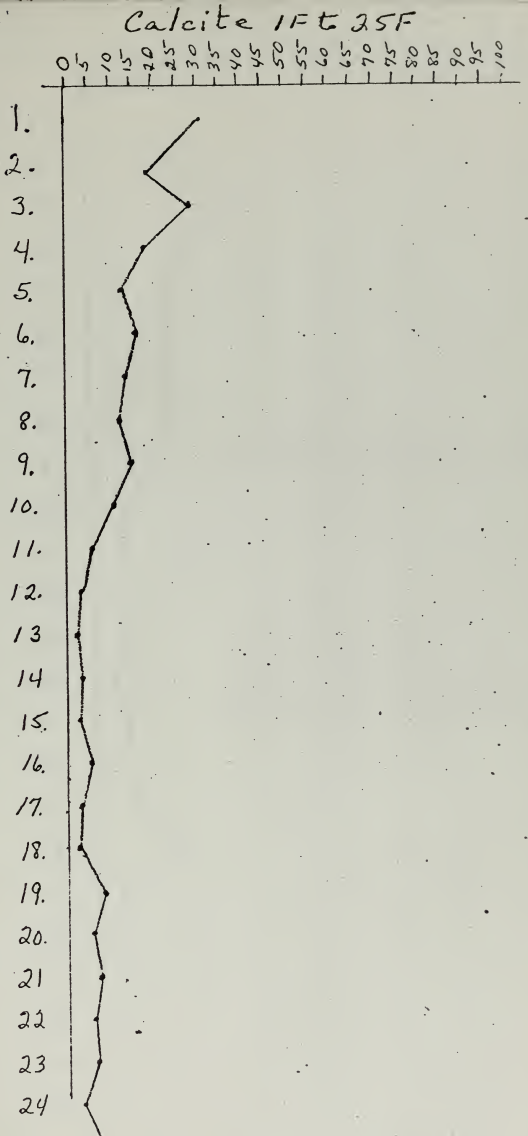
23
24


Calcite 1Ft 25F
0 5 10 15 20 25 30 35 40 45 50 55 60 65 70 75 80 85 90 95 100
1.
2.
3.
4.
5.
6.
7.
8.
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16.
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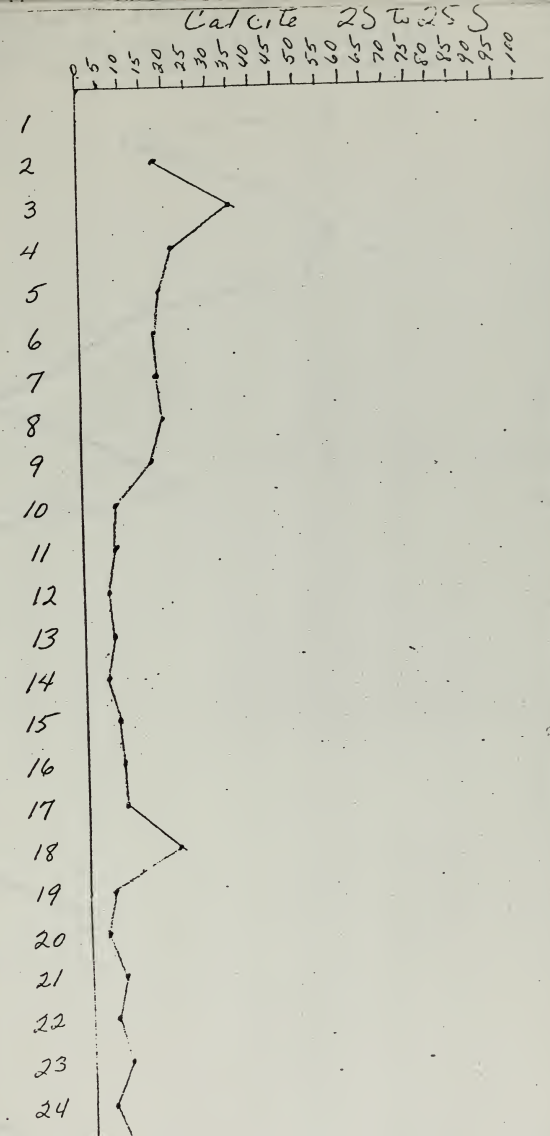
23
24


Calcite 25 E 25 S
0 5 10 15 20 25 30 35 40 45 50 55 60 65 70 75 80 85 90 95 100
1
2
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23
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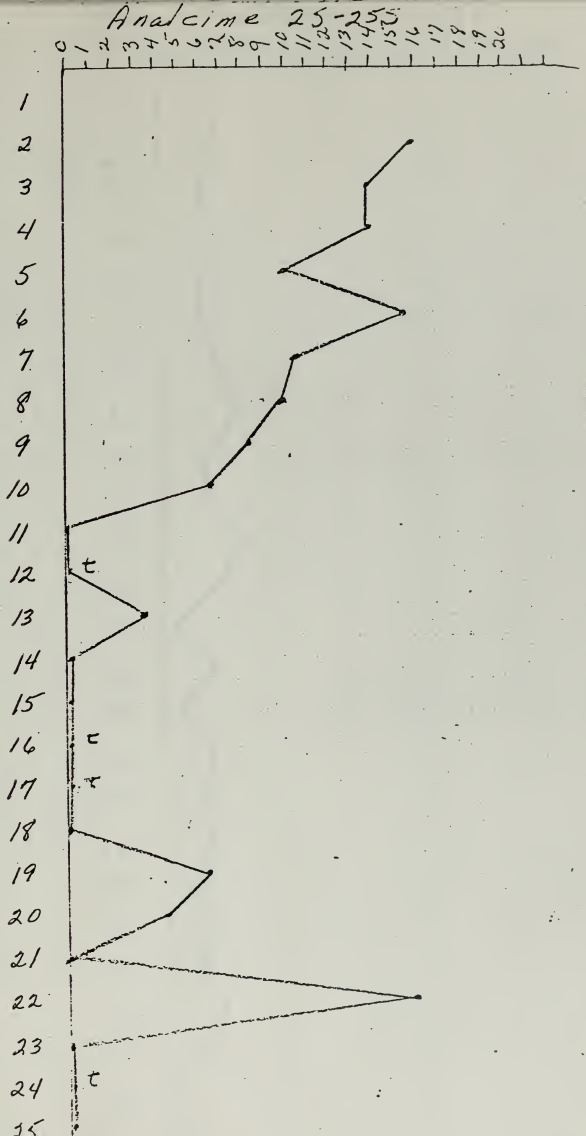
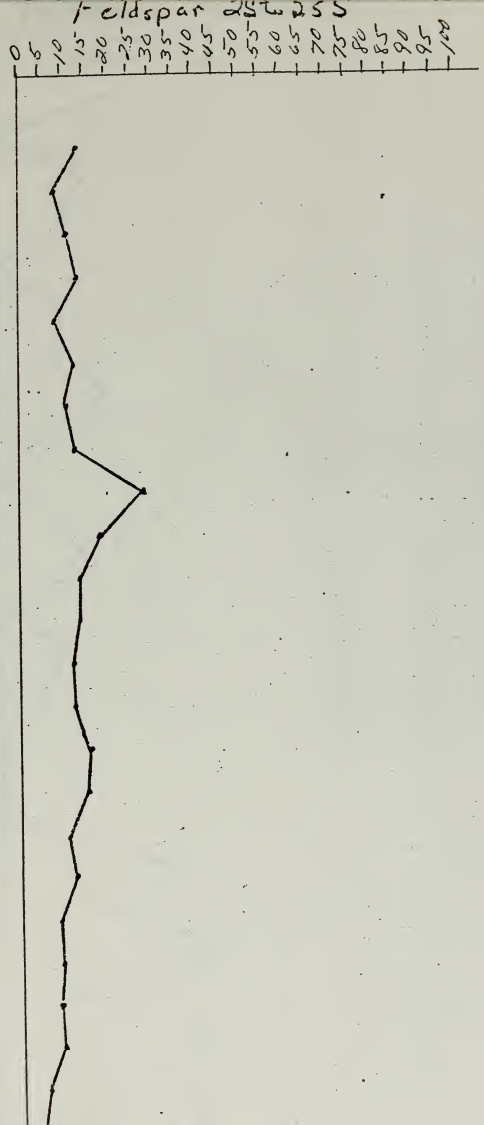
Analcime 1F-25F


Analcime 25-25
0 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20
1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25
t
t
t

Feldspar 1F-25F


Feldspar 25 to 255
0
5
10
15
20
25
30
35
40
45
50
55
60
65
70
75
80
85
90
95
100
1
2
3
4
5
6
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8
9
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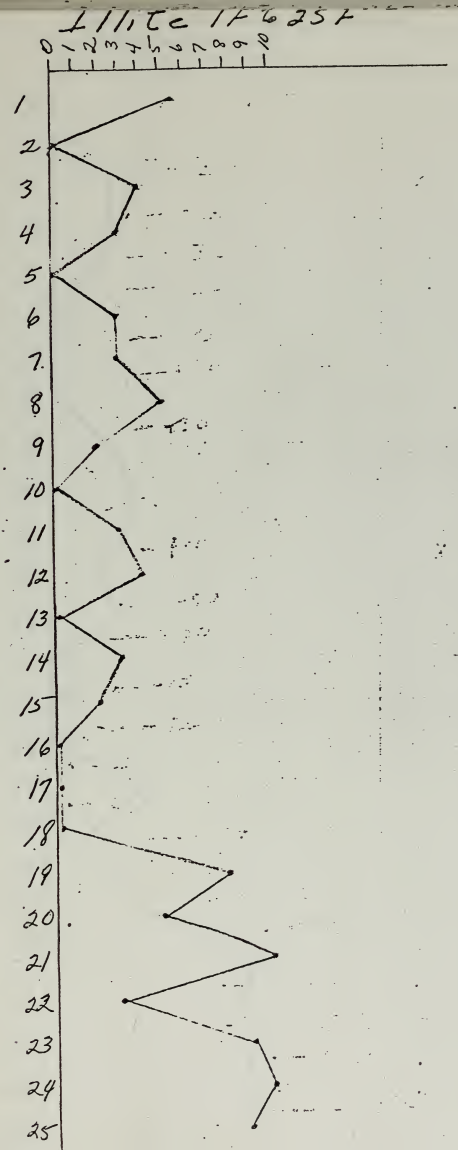
11
12
13
14
15
16
17
18
19
20
21
22
23
24


Illite IF 625
0 1 2 3 4 5 6 7 8 9 10
1
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3
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5
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9
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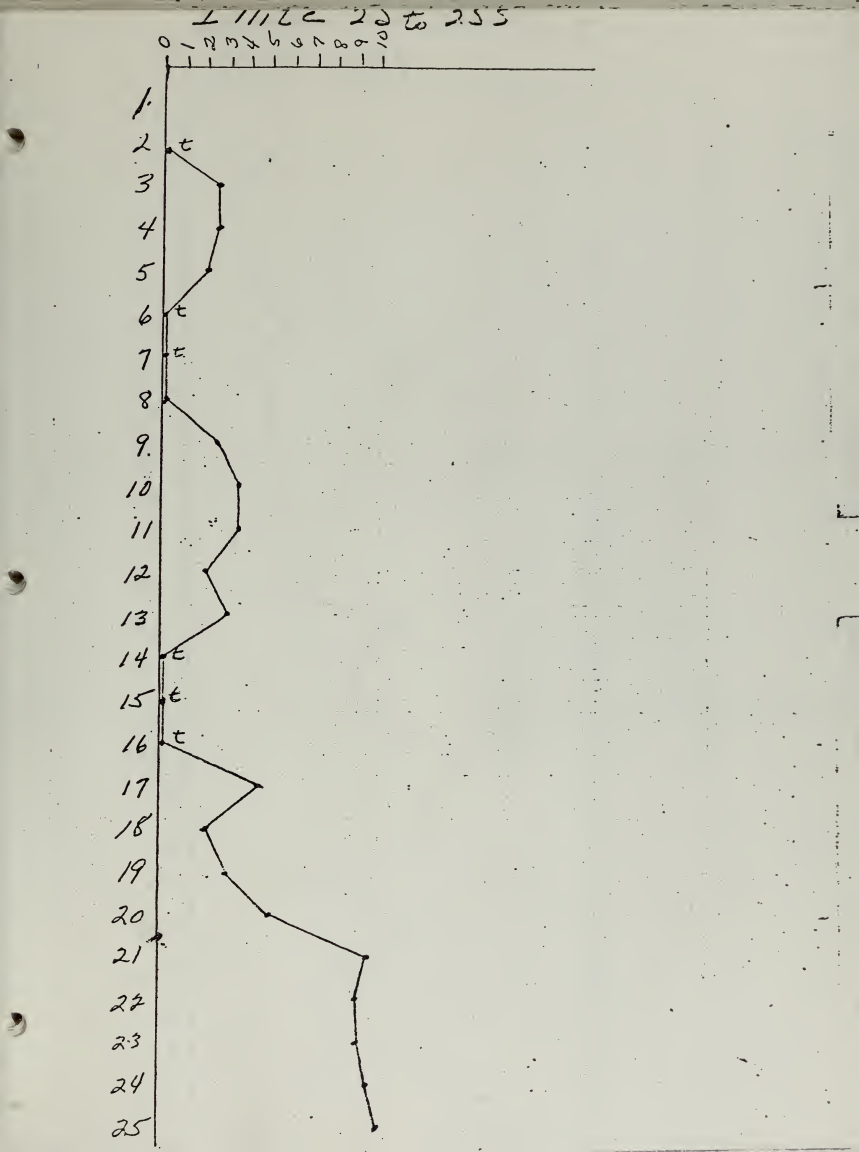
24
25


Trial 22 to 255
0 1 2 3 4 5 6 7 8 9 10
1.
2
3
4
5
6
7
8
9.
10
11
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13
14
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21
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25
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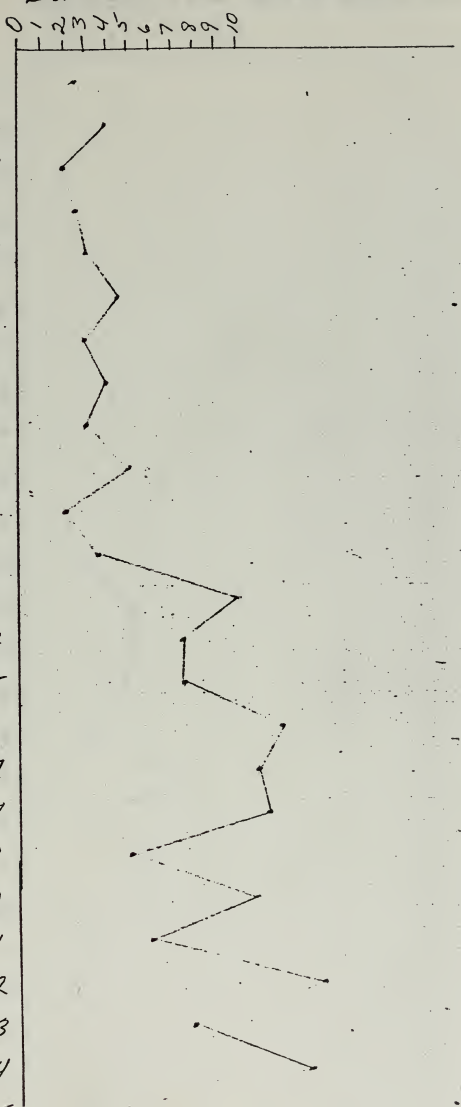
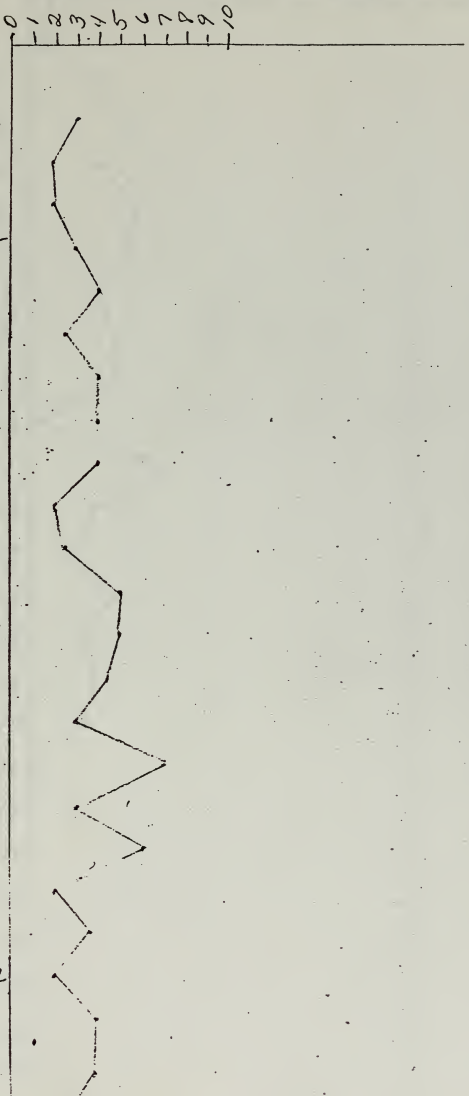
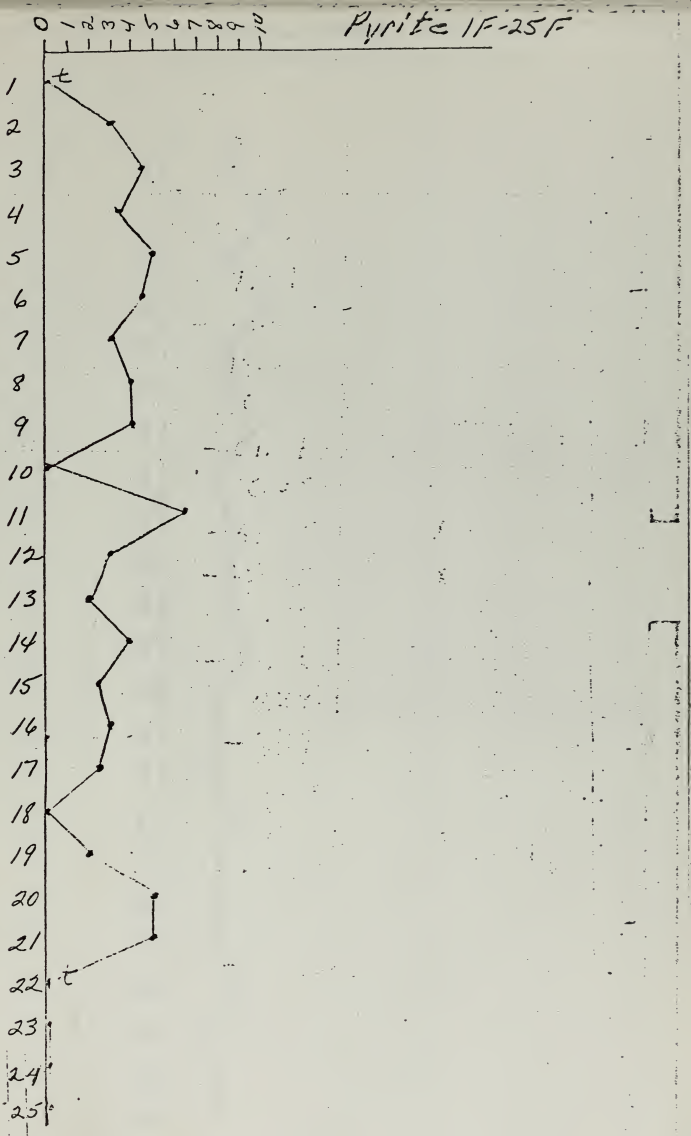
t
t
t
t

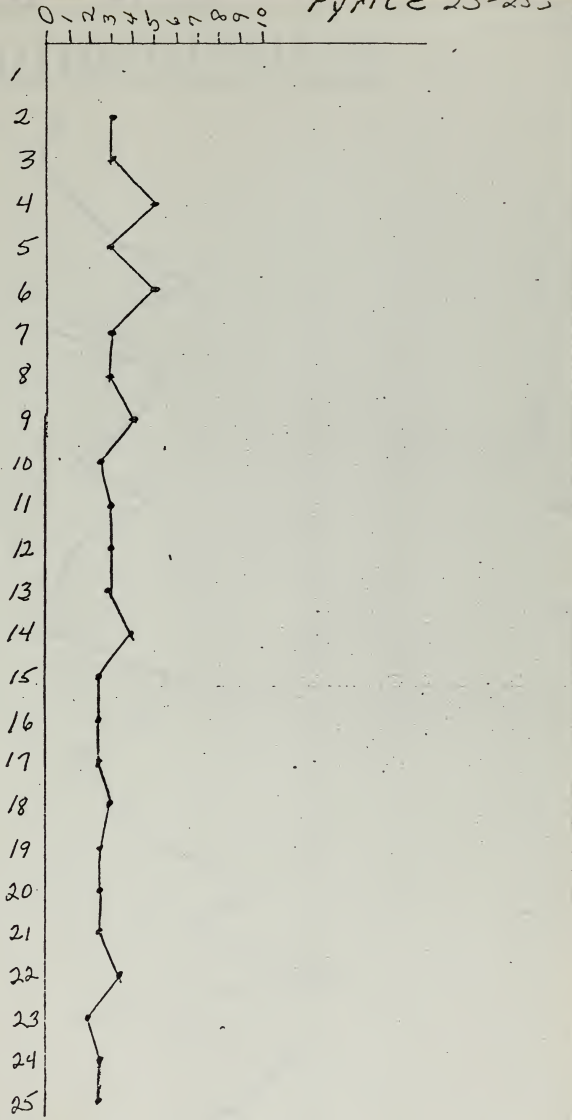
Dawsonite 11- to 23 F



Dawsonite 25 to 255




Pyrite 1F-25F
0 1 2 3 4 5 6 7 8 9 10
t
1
2
3
4
5
6
7
8
9
10
11
12
13
14
15
16
17
18
19
20
21
22
t
23
24
25


0 1 2 3 4 5 6 7 8 9 10
Pyrite 23-253
1
2
3
4
5
6
7
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9
10
11
12
13
14
15
16
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18
19
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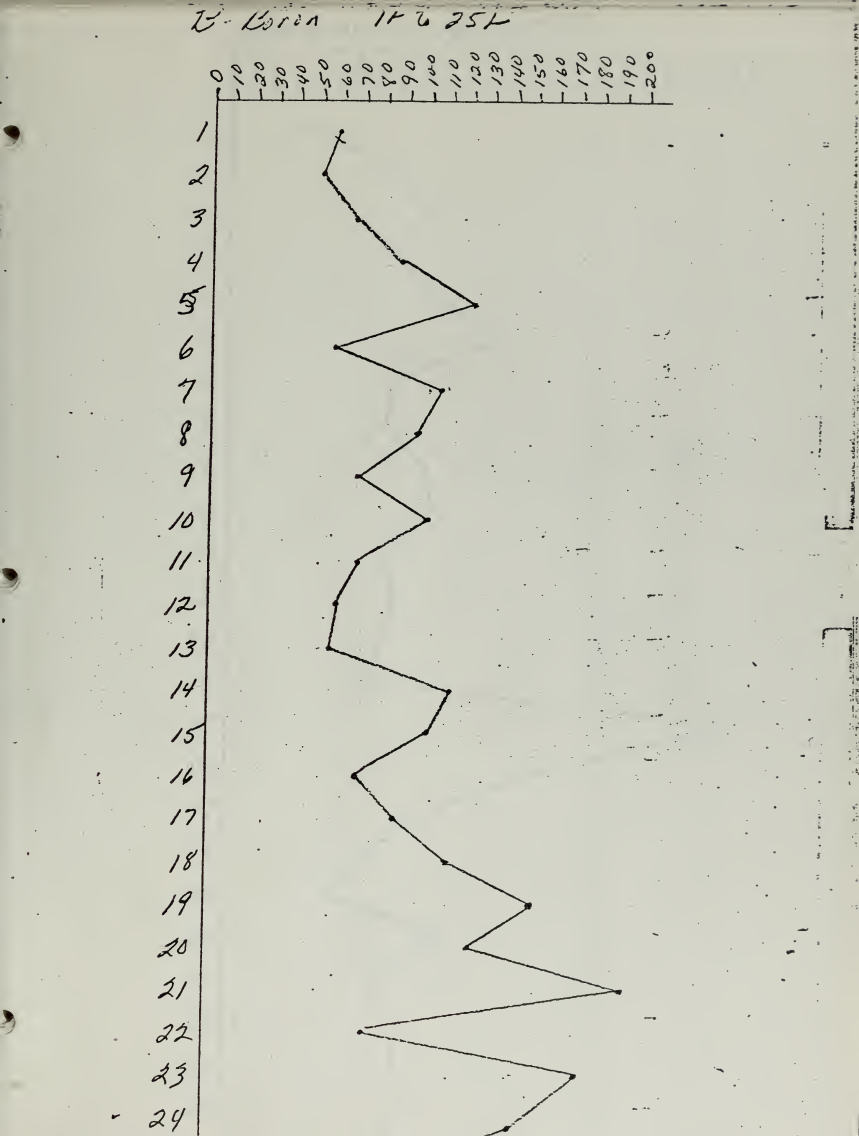
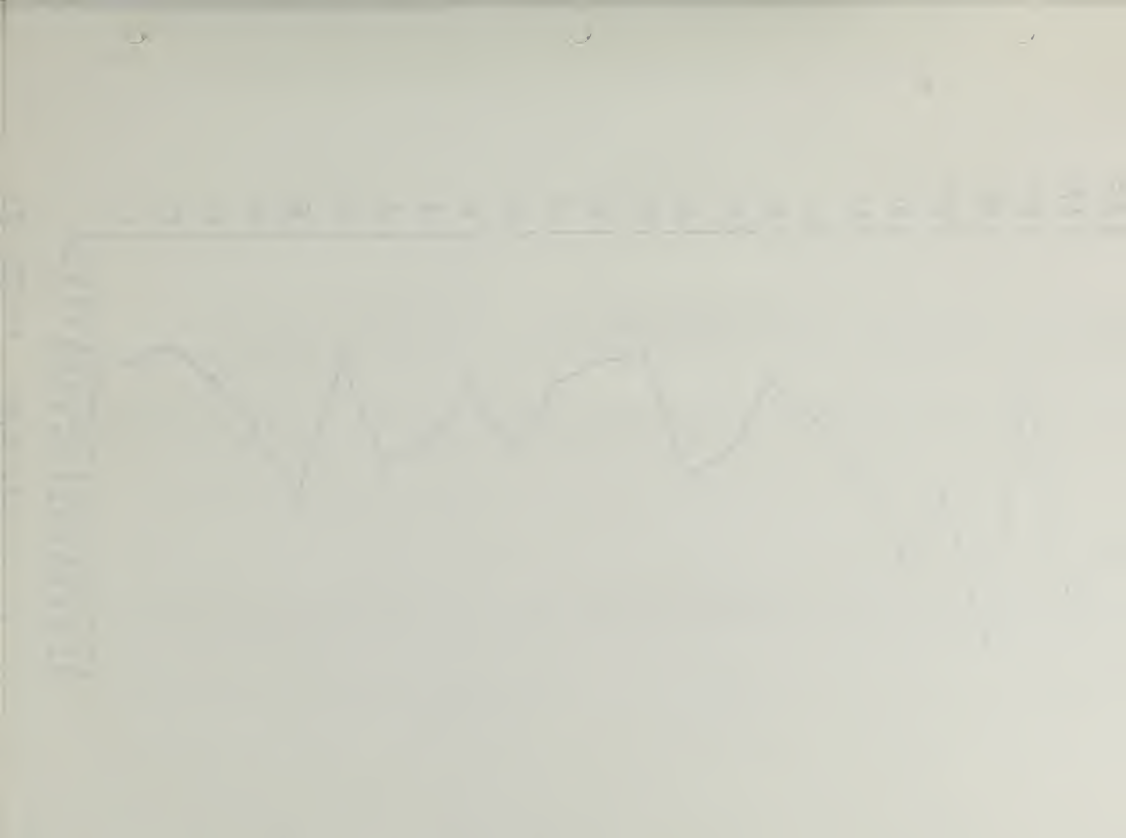
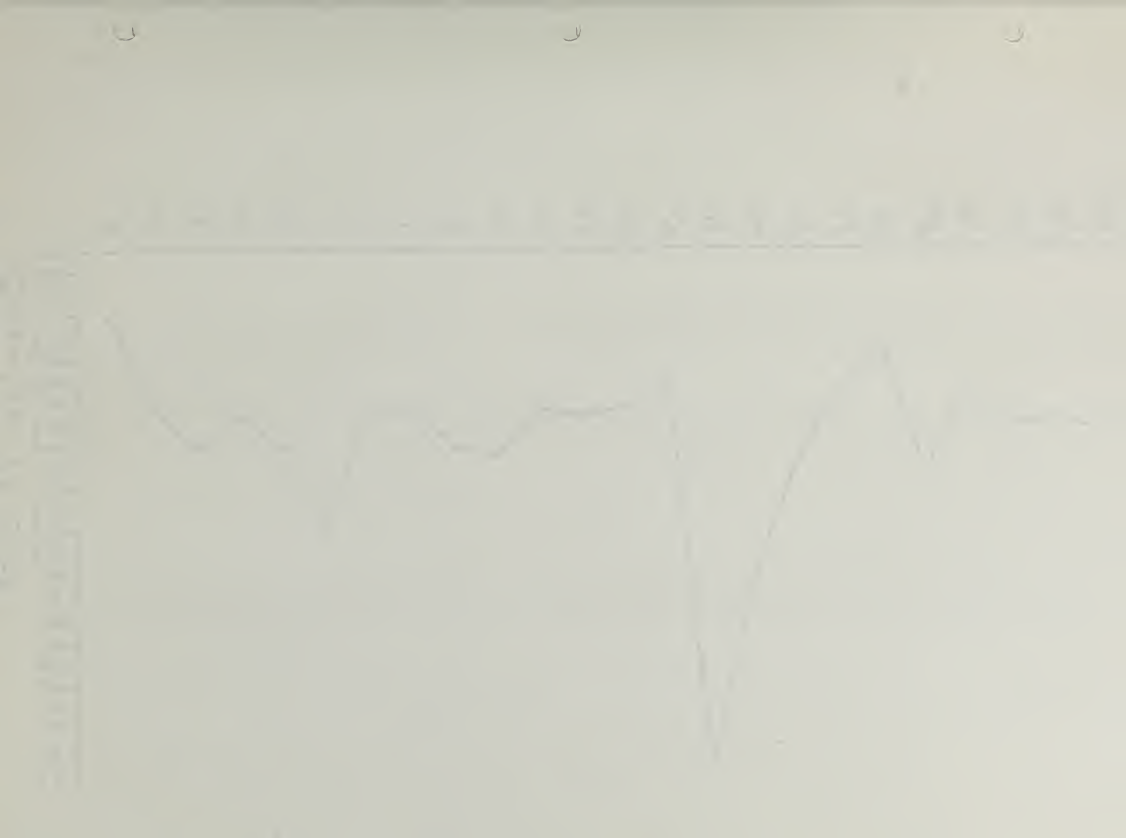
22
23
24
25


E-Koren 1F6 25L
0 10 20 30 40 50 60 70 80 90 100 110 120 130 140 150 160 170 180 190 200
1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24



Cadmium 1F-25F



Cadmium
1.0
1.2
1.4
1.6
1.8
2.0
2.2
2.4
2.6
2.8
3.0
3.2
3.4
3.6
3.8
4.0
1
2
3
4
5
6
7
8
9
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11
12
13
14
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19
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21
22
23
24

MS - Arsenic 11-26-25
.5
.7
1.0
1.2
1.4
1.6
1.8
2.0
2.2
2.4
2.6
2.8
3.0
3.5
4.0
4.5
5.0
5.5
6.0
6.5
7.0
7.5
8.0
10
12
1
2
3
4
5
6
7
8
9
10
11
12
13
14
15
16
17
18
19
20
21
22
23
24
25

Arsenic
25-255

Antimony
1F-25F
0.0
.2
.4
.6
.8
.9
1.0
1.2
1.4
1.6
1.9
2.0
2.2
2.4
2.
2.
3.
3.
3.
3.
4
1
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4
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24
25

Antimony
25-255

Mercury
1F-25F

0.0
.2
.4
.6
.8
1.0
1.2
1.4
1.6
1.8
2.0
2.2
2.4
2.6
2.8
3
1
2
3
4
5
6
7
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12
13
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17
18
19
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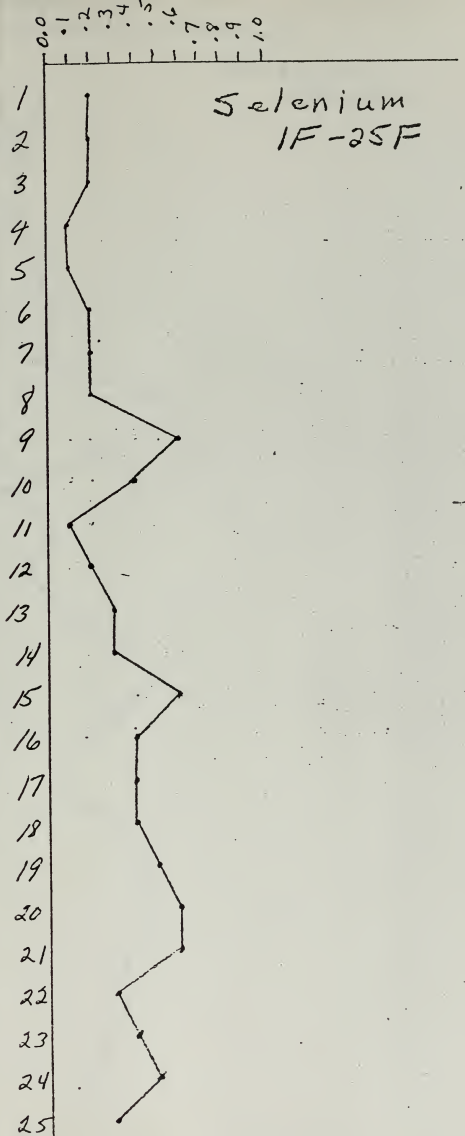
21
22
23
24
25
Mercury
25-255


0.0
.1
.2
.3
.4
.5
.6
.7
.8
.9
1.0
1
2
3
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9
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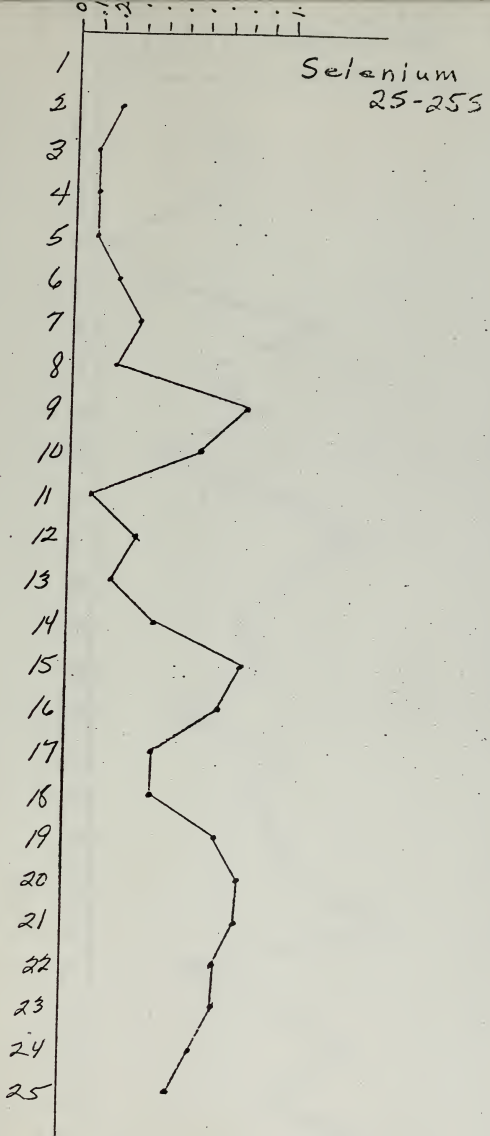
22
23
24
25
Selenium
1F-25F


Selenium
25-255
1
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10
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12
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21
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Fluoride

50
100
150
200
250
300
350
400
450
500
550
600
650
700
750
800

1
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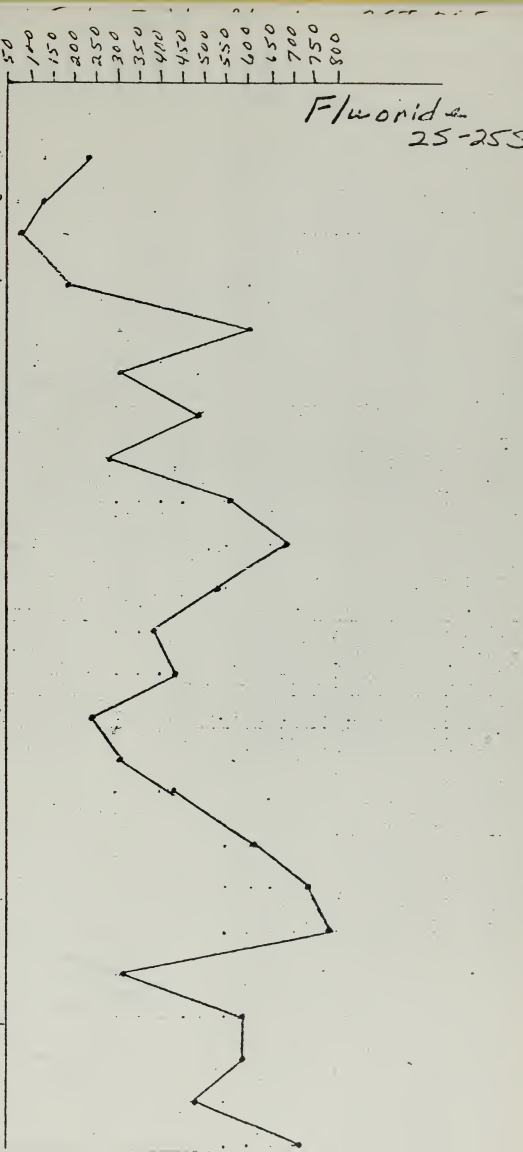
25


50
100
150
200
250
300
350
400
450
500
550
600
650
700
750
800
1
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4
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6
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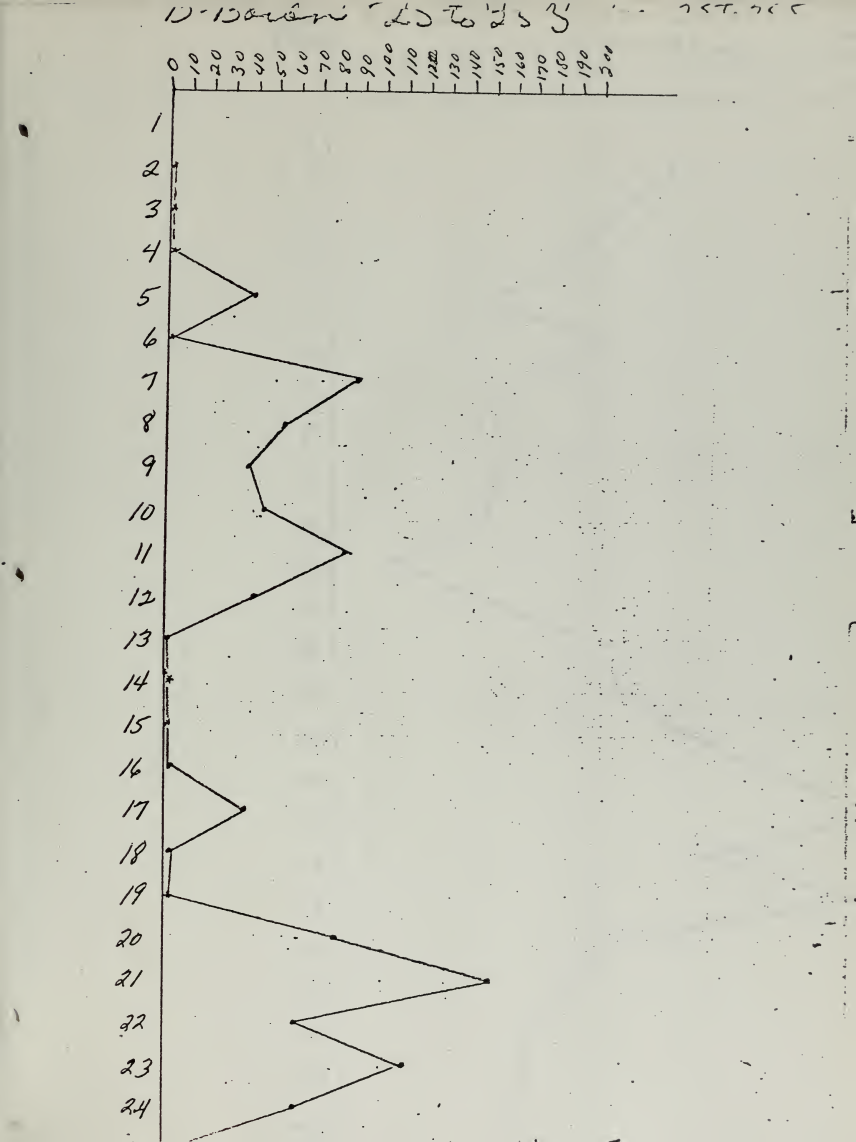
19
20
21
22
23
24
Fluoride
25-25


0
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90
100
110
120
130
140
150
160
170
180
190
200
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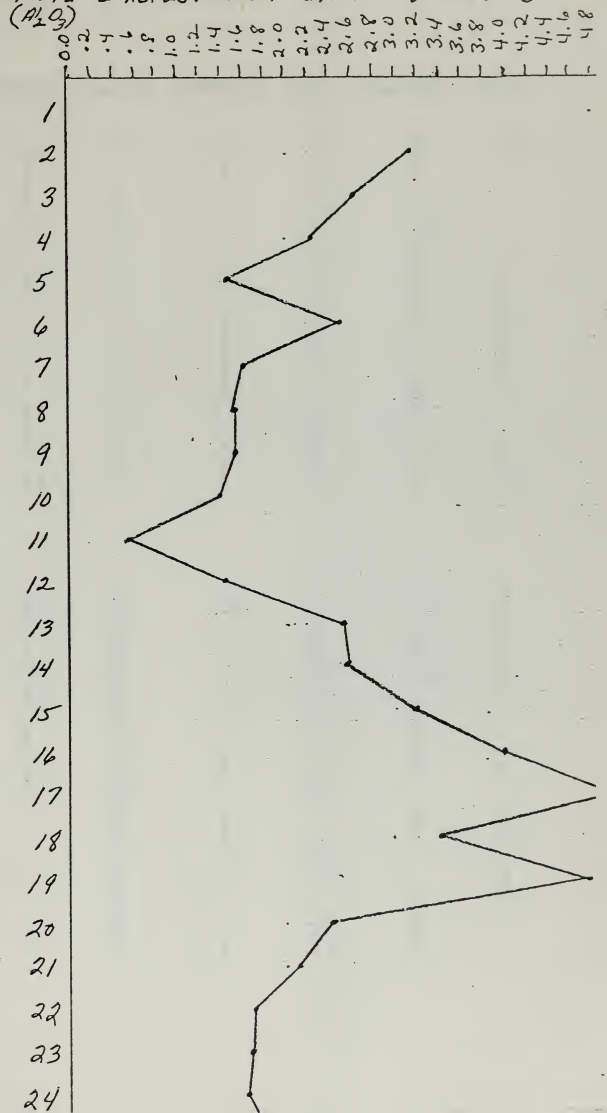
24

Acid Extractable Alumina 25 to 255

(Al_2O_3)



Cadmium 26-47 Fresh

	Quartz	Dolomite	Calcite	Analcime	Andescine	Illite	Dawsonite	Pyrite
26.	-	4	3	-	-	-	-	3
27.	-	-	-	3.3	-	-	3.3	3.3
28.	-	-	5	-	-	5	-	-
29.	-	3	3	-	4	-	-	-
30.	-	-	4	3	-	3	-	-
31.	-	-	4	6	-	-	-	-
32.	-	2.5	2.5	2.5	-	-	2.5	-
33.	-	6	2	-	-	-	2	-
34.	-	-	-	4	-	-	6	-
35.	-	-	3	-	-	-	7	-
36.	-	1	-	1	-	4	2	2
37.	-	-	6	-	2	-	-	2
38.	-	-	-	-	2	5	-	3
39.	-	2	-	2	1	1	-	4
40.	-	2	1	1	1	-	-	5
41.	-	1	1	-	2	-	5	1
42.	-	3	3	3	-	-	1	-
43.	-	3	3	-	1	3	-	-
44.	-	3	3	-	-	3	-	1
45.	-	2	-	2	4	-	-	2
46.	-	1	3.5	1	-	1	-	3.5

Cadmium 26-47 Spent

26.	-	5	-	1	-	1	-	3
27.	-	1	2.5	1	2.4	-	1	2
28.	-	2	2	2	-	2	-	2
29.	-	-	1	5	-	3	1	-
30.	-	1	2	3	-	1	1	2
31.	-	.5	2	3	-	2	.5	2
32.	-	1	3	2	-	1	1	2
33.	-	2	1	2	-	1	-	4
34.	-	2	2	2	-	-	4	-
35.	-	1	3	-	-	-	6	-
36.	-	1	1	2	2	-	2	2
37.	-	-	2	4	-	4	-	-
38.	-	-	-	6	-	-	-	4
39.	-	1	-	3	1	-	4	1
40.	-	3	-	-	5	-	-	2
41.	-	3	-	3	-	4	-	-
42.	-	4	-	4	-	-	-	2
43.	-	2.5	-	5	-	-	-	2.5
44.	-	2	-	2	-	-	3	3
45.	-	2	-	2	-	2	4	-
46.	-	-	-	3	2	2	3	-

Arsenic 25-47 Fresh

	Quartz	Dolomite	Calcite	Analcime	Andesine	Illite	Dawsonite	Pyrite
26.	-	-	3	-	-	-	-	3
27.	3	2	-	-	-	2	3	-
28.	-	-	5	-	-	5	-	-
29.	-	3	3	-	4	-	-	-
30.	2	-	4	3	-	1	-	-
31.	2	-	4	4	-	-	-	-
32.	-	-	-	-	5	1	-	4
33.	-	-	-	3	2	2	-	3
34.	-	-	3	3	-	-	1	3
35.	-	3	1	2	2	1	-	1
36.	-	2	-	1	1	3	1	2
37.	1	-	5	-	-	-	-	4
38.	1	1	3	3	-	-	2	-
39.	2	-	5	-	-	-	3	-
40.	-	5	1	-	1	-	-	4
41.	1	-	2	-	3	-	4	-
42.	-	3	3	3	-	-	1	-
43.	-	4	4	-	-	2	-	-
44.	-	4	2	-	-	4	-	-
45.	-	-	3	-	-	3	4	-
46.	-	-	-	-	4	-	6	-

Arsenic 26-47 Spent

26.	2.5	-	2.5	-	2.5	-	2.5	-
27.	2	-	-	4	-	-	4	-
28.	2	2	2	2	-	2	-	-
29.	-	4	-	-	6	-	-	-
30.	2	1	2	2	-	1	1	1
31.	1	1	2	2	-	2	1	1
32.	1	2	1	1	-	2	2	1
33.	-	-	-	-	10	-	-	-
34.	-	-	-	-	7	-	-	3
35.	-	2	3	-	-	-	5	-
36.	2	-	2	2	2	2	-	-
37.	2	3	-	-	2	-	3	-
38.	-	3	4	-	3	-	-	-
39.	-	1	-	2	3	-	2	2
40.	-	3	-	1	3	-	-	3
41.	1	-	1	-	3	-	1	4
42.	-	4	-	3	-	-	-	3
43.	2	2	-	3	-	-	-	3
44.	-	2	-	2	-	-	3	3
45.	-	3	-	1	-	2	4	-
46.	-	-	-	3	2	2	3	-

Antimony 26-47 Fresh

	Quartz	Dolomite	Calcite	Analcime	Andescine	Illite	Dawsonite	Pyrite
26.	-	5	1	-	-	-	-	4
27.	1	-	-	4	-	-	2	3
28.	-	-	5	-	-	4	1	-
29.	3	-	-	4	-	-	3	-
30.	-	1	-	-	3	-	3	3
31.	-	2	-	-	3	-	2	3
32.	-	-	-	-	3	3	-	3
33.	-	-	-	2	2	3	-	5
34.	-	1	3	1	-	-	-	5
35.	-	3	3	2	2	-	-	2
36.	-	1	-	1	-	4	2	2
37.	-	-	8	-	-	-	-	3
38.	-	-	-	-	2	5	-	3
39.	2	-	4	-	-	2	4	-
40.	1	-	2	1	1	5	2	-
41.	1	-	2	-	3	-	4	-
42.	3	-	-	-	-	4	-	3
43.	1	-	-	4	-	-	3	2
44.	2	-	-	5	1	-	2	-
45.	-	-	3.3	-	-	3.3	3.3	-
46.	-	-	-	-	4	-	6	-

Antimony 26-47 Spent

26.	2	-	3	-	3	-	2	-
27.	1	-	-	4	-	-	4	1
28.	2	2	-	1	-	-	-	5
29.	2	-	2	3	-	2	1	-
30.	-	-	-	-	10	-	-	-
31.	-	-	-	-	10	-	-	-
32.	-	-	-	-	10	-	-	-
33.	2	-	1	2	-	-	5	-
34.	4	1	1	1	-	-	3	-
35.	1	3	4	-	-	-	1	1
36.	-	4	-	2	-	-	2	2
37.	-	-	3	4	-	3	-	-
38.	2	-	-	4	-	-	-	4
39.	-	1	-	2	1	-	3	3
40.	-	4	-	-	2	-	-	4
41.	1	3	-	6	-	-	-	-
42.	2	-	2	-	1	3	2	-
43.	-	-	3	-	2	3	2	-
44.	3	-	-	1	3	3	-	-
45.	-	3	-	1	-	3	3	-
46.	-	-	-	2	1	2	4	1

Mercury 26-47 Fresh

	Quartz	Dolomite	Calcite	Analcime	Andescine	Illite	Dawsonite	Pyrite
26.	-	5	3	-	-	-	-	2
27.	-	2	3	-	3	2	-	-
28.	-	-	6	-	-	4	-	-
29.	2	-	-	7	-	-	1	-
30.	2	-	4	3	-	1	-	-
31.	2	-	3	5	-	-	-	-
32.	-	-	-	-	4	2	-	4
33.	-	-	-	2	2	2	-	4
34.	-	1	1	-	4	3	-	1
35.	4	-	2	-	-	-	4	-
36.	4	-	4	-	1	-	1	-
37.	-	-	8	-	1	-	-	1
38.	-	-	-	-	4	3	-	3
39.	-	2	-	1	1	1	-	5
40.	1	4	-	-	1	-	-	4
41.	1	-	2	-	3	-	4	-
42.	3	-	-	-	-	3	-	4
43.	-	4	4	-	-	2	-	-
44.	-	3	3	-	-	3	-	1
45.	-	-	4	-	-	3	3	-
46.	-	-	-	1	2	1	6	-

Mercury 26-47 Spent

26.	-	4	-	1	-	2	-	3
27.	-	2	2	-	2	3	-	1
28.	2	2	1	2	-	1	-	2
29.	-	4	-	-	5	-	-	1
30.	1	1	2	2	-	1	1	2
31.	.5	.5	2	2	-	2	1	2
32.	-	1	3	1	-	1	1	3
33.	-	-	-	-	10	-	-	-
34.	-	3	3	2	-	2	-	-
35.	-	-	-	-	-	-	10	-
36.	-	4	-	1	1	-	2	2
37.	-	-	3	3	-	4	-	-
38.	2	-	-	4	-	-	-	4
39.	-	2	-	2	2	-	2	2
40.	-	4	-	-	2	-	-	4
41.	1.5	-	1.5	-	1.5	-	1.5	4
42.	2	-	2	-	2	2	2	-
43.	2	3	-	3	-	-	-	2
44.	-	2	-	1	-	-	3	4
45.	-	3	-	2	-	2	3	-
46.	-	-	-	2	1	2	4	1

Selenium 26-47 Fresh

	Quartz	Dolomite	Calcite	Analcime	Andesine	Illiite	Dawsonite	Pyrite
26.	-	4	3	-	-	-	-	3
27.	3	3	-	-	-	1	3	-
28.	1	2	-	2	3	-	-	2
29.	-	-	-	-	-	4	2	4
30.	2	-	4	2	-	2	-	-
31.	3	-	3	4	-	-	-	-
32.	1	1	-	5	-	-	3	-
33.	-	-	-	2	2	2	-	4
34.	4	-	-	2	-	-	4	-
35.	-	1	-	1	2	3	-	3
36.	-	2	-	2	-	2	2	2
37.	-	-	10	-	-	-	-	-
38.	-	-	-	-	2	4	-	4
39.	3	-	3	-	-	-	4	-
40	-	5	-	-	-	-	-	5
41.	-	1	-	3	-	3	-	3
42.	-	3	3	2	-	-	2	-
43.	-	3	4	-	-	3	-	-
44.	2	-	-	4	2	-	2	-
45.	1	1	-	4	1	-	-	3
46.	-	-	-	4	2	-	4	-

Selenium 26-47 Spent

26.	-	4	-	1	-	2	-	3
27.	1	-	-	4	-	-	4	1
28.	1	2	3	2	-	2	-	-
29.	1	-	2	4	-	2	1	-
30.	2	2	-	-	-	4	2	-
31.	1	1	2	2	-	1	1	2
32.	1	1	2	2	-	1	1	2
33.	1	1	1	1	-	2	-	4
34.	3	1	1	1	-	-	4	-
35.	1	1	1	2	2	2	-	1
36.	2	-	2	1	2	2	-	1
37.	-	-	3	4	-	3	-	-
38.	2	-	-	4	-	-	-	4
39.	2	-	5	-	-	3	-	-
40.	2	-	2	-	-	4	2	-
41.	1	3	1	2	1	1	1	-
42.	-	4	-	4	-	-	-	2
43.	2	2	-	4	-	-	-	2
44.	-	2	-	1	-	-	3	4
45.	2	-	-	1.5	-	1.5	-	5
46.	-	-	-	2	1	2	4	1

Fluoride 26-47 Fresh

	Quartz	Dolomite	Calcite	Analcime	Andescine	Illite	Dawsonite	Pyrite
26.	3	-	-	1	2	2	2	-
27.	2	-	-	3	-	-	2	3
28.	-	-	5	-	-	5	-	-
29.	3	-	-	4	-	-	3	-
30.	2	-	3	3	-	2	-	-
31.	3	-	3	4	-	-	-	-
32.	2	2	-	4	-	-	2	-
33.	-	-	-	2	2	2	-	4
34.	4	-	-	2	-	-	4	-
35.	-	1	-	2	1	2	-	4
36.	3	1	2	1	3	-	-	-
37.	-	-	10	-	-	-	-	-
38.	-	-	-	-	3	4	-	3
39.	-	2	-	2	2	1	-	3
40.	-	5	-	-	-	-	-	5
41.	-	1	-	3	-	3	-	3
42.	-	4	2	2	-	-	2	-
43.	-	4	4	-	-	2	-	-
44.	-	4	3	-	-	3	-	-
45.	-	-	3	-	-	3	4	-
46.	-	-	-	-	4	-	6	-

Fluoride 26-47 Spent

26.	2.5	-	2.5	-	2.5	-	2.5	-
27.	2	-	-	4	-	-	4	-
28.	-	-	-	-	4	-	4	2
29.	2	-	2	2	-	2	2	-
30.	1	1	2	2	-	1	1	2
31.	1	1	2	1	-	2	1	2
32.	-	-	-	-	10	-	-	-
33.	-	-	-	-	10	-	-	-
34.	4	2	1	1	-	-	2	-
35.	1	1	1	2	2	2	-	1
36.	-	-	1	2	2	1	2	2
37.	1	1	2	3	-	-	-	3
38.	2	-	-	4	-	-	-	4
39.	-	1	1	3	1	-	3	2
40.	2	-	2	-	-	4	2	-
41.	-	3	-	3	-	4	-	-
42.	-	4	-	4	-	-	-	2
43.	2	2	-	3	-	-	-	3
44.	-	.5	-	.5	2	-	3	4
45.	-	2	-	2	-	2	3	-
46	-	-	-	3	1	2	4	-

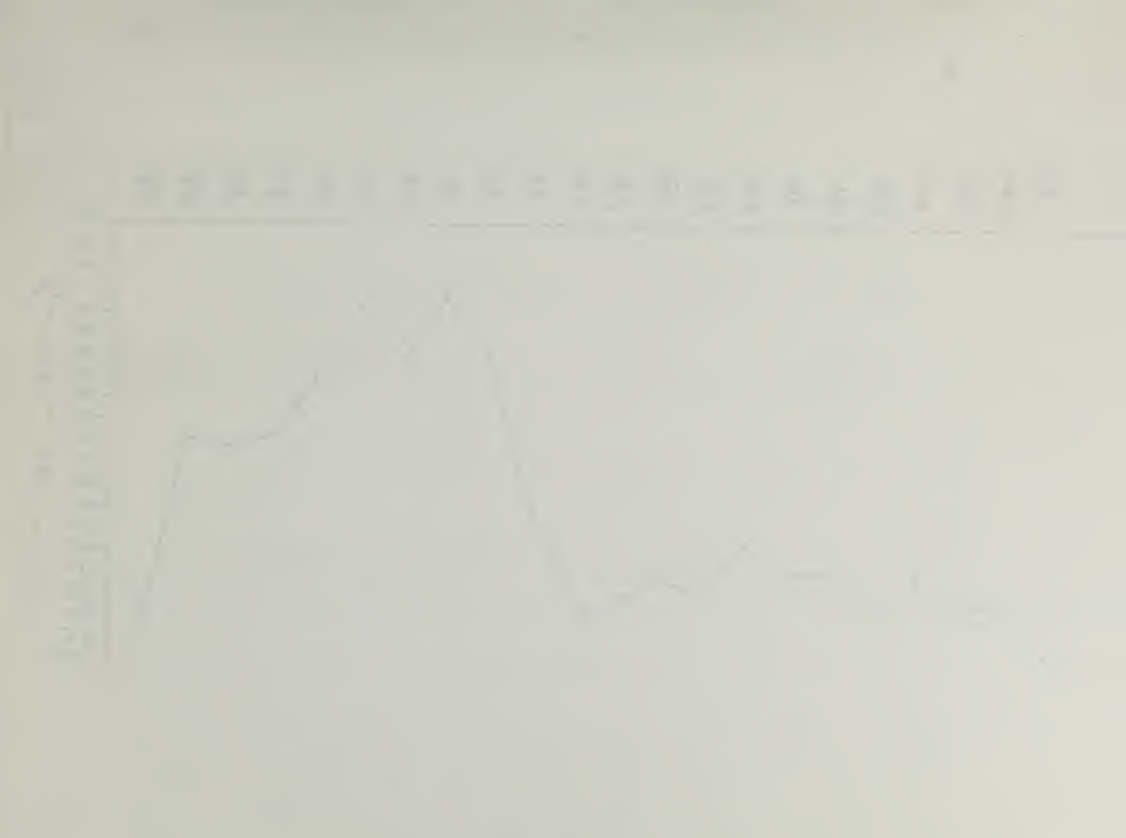
Boron 26-47 Fresh

	Quartz	Dolomite	Calcite	Analcime	Andescine	Illite	Dawsonite	Pyrite
26.	-	4	3	-	-	-	-	3
27.	-	1	5	-	2	2	-	-
28.	1	-	4	-	-	3	1	1
29.	1	-	-	1	-	2	4	2
30.	-	2	-	-	4	-	2	2
31.	-	1	-	-	4	-	1	4
32.	2	2	3	1	-	-	2	-
33.	3	5	1	-	-	-	1	-
34.	4	-	-	2	-	-	4	-
35.	-	2	-	1	2	2	-	3
36.	3	1	3	1	1	1	-	-
37.	-	-	6	-	2	-	-	2
38.	1	2	3	2	-	-	2	-
39.	2	-	4	-	-	-	3	-
40.	1	-	3	2	2	1	1	-
41.	-	1	-	3	-	3	-	3
42.	3	-	-	-	-	2	-	5
43.	2	-	-	3	-	-	2	3
44.	-	2	2	3	-	2	-	1
45.	-	-	2	4	-	2	2	-
46.	-	-	-	2	3	-	5	-

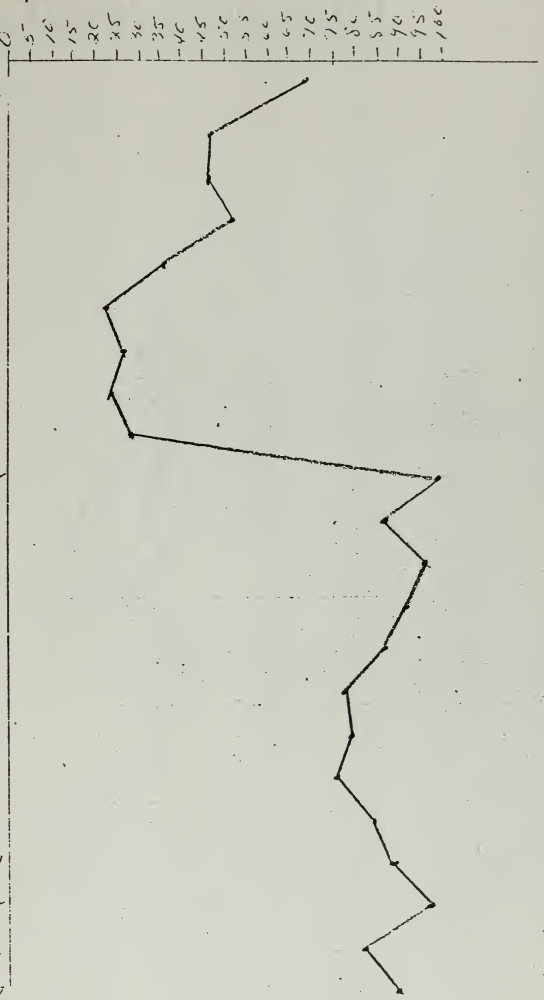
Boron 26-47 Spent

26.	3	-	2	-	2	-	3	-
27.	-	2	3	-	2	3	-	-
28.	1	1	2	3	-	3	-	-
29.	1	-	1	3	-	3	1	1
30.	-	-	-	-	10	-	-	-
31.	-	-	-	-	10	-	-	-
32.	1	1	2	1	-	1	1	3
33.	1	2	1	1	-	2	-	3
34.	4	1	1	2	-	-	2	-
35.	1	1	1	2	2	2	-	1
36.	-	3	-	2	1	-	2	2
37.	-	-	2	5	-	3	-	-
38.	2	1	1	-	-	4	4	-
39.	3	4	-	-	3	-	-	-
40.	-	4	-	-	3	-	-	3
41.	-	3	-	3	-	4	-	-
42.	-	5	-	3	-	-	-	2
43.	1	2	-	4	-	-	-	3
44.	-	2	-	2	-	-	3	3
45.	2	-	5	-	3	-	-	-
46.	2	3	5	-	-	-	-	-

Quartz 26F – 47F



Quartz 265 - 475



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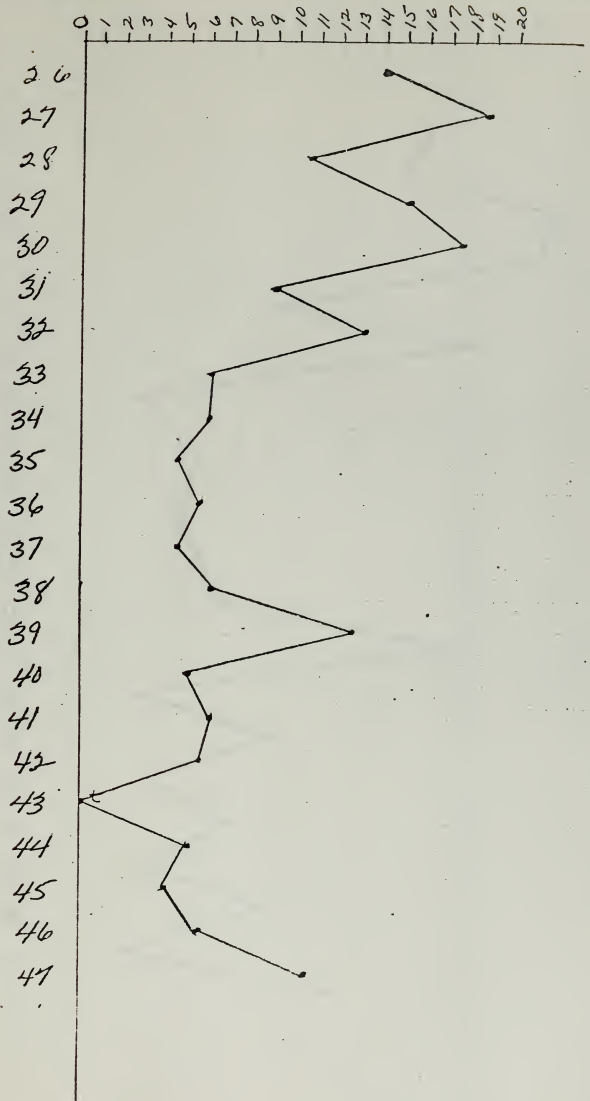
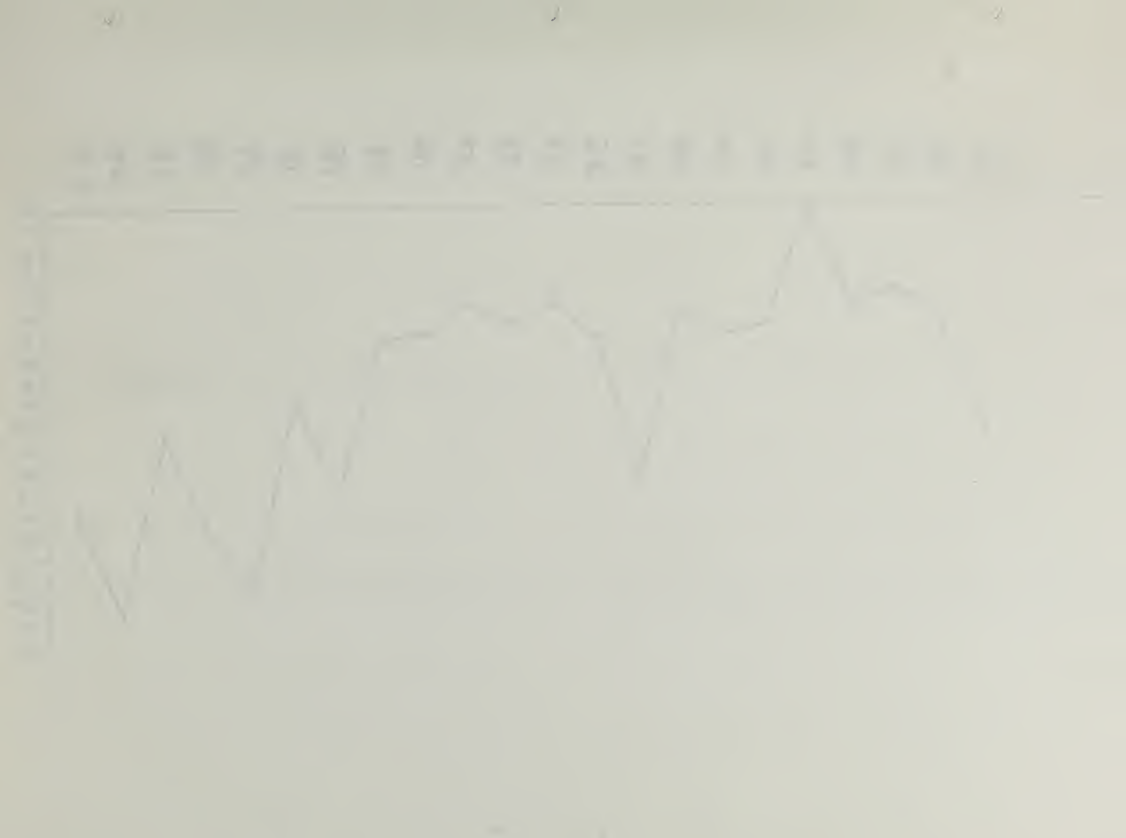
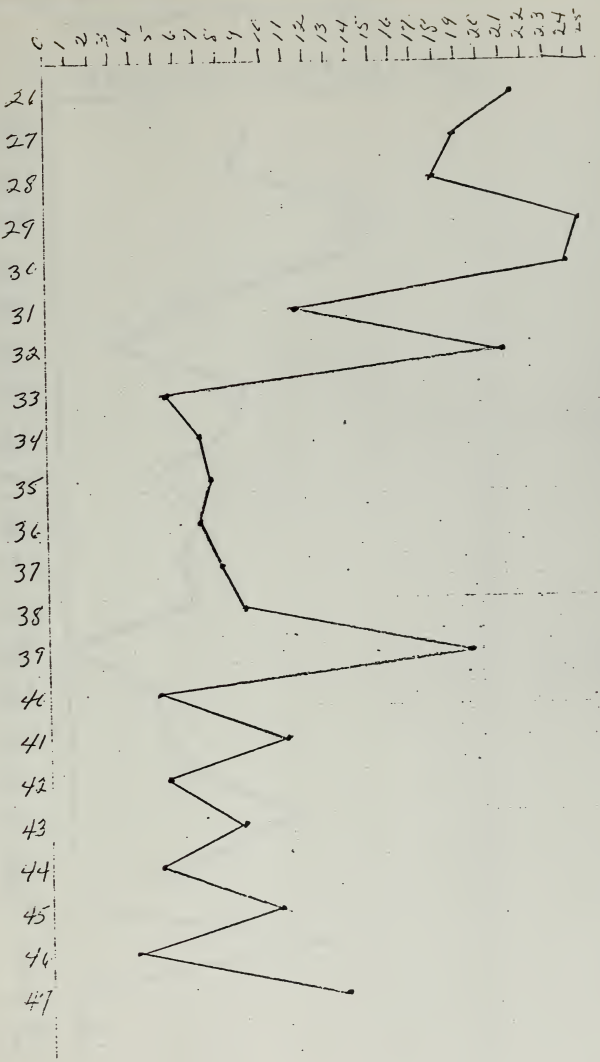
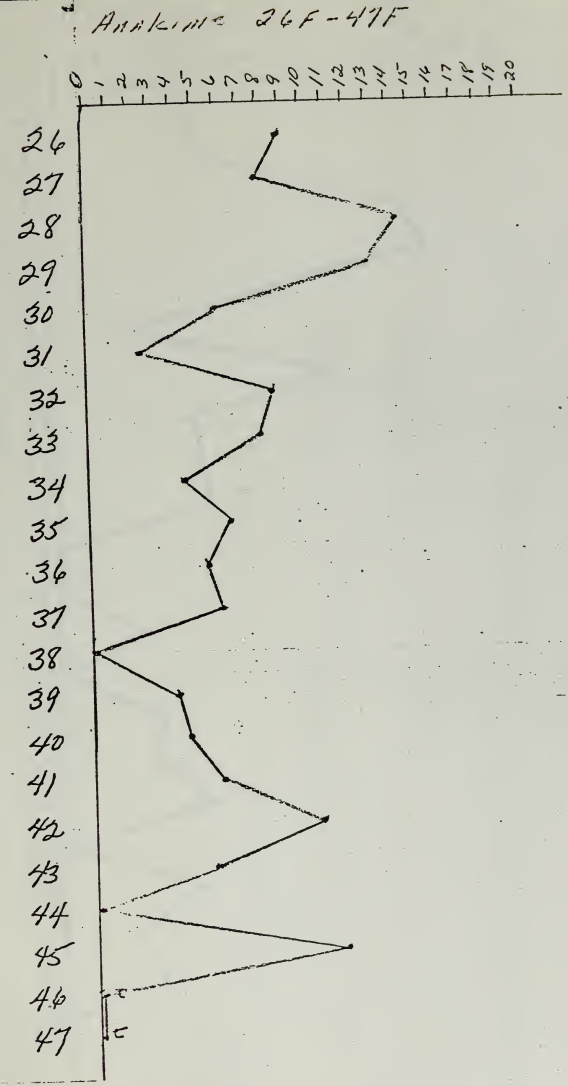
Cr Tcl Ti 26F to 47F





Calcite 263 – 415




Analcime 26F-47F
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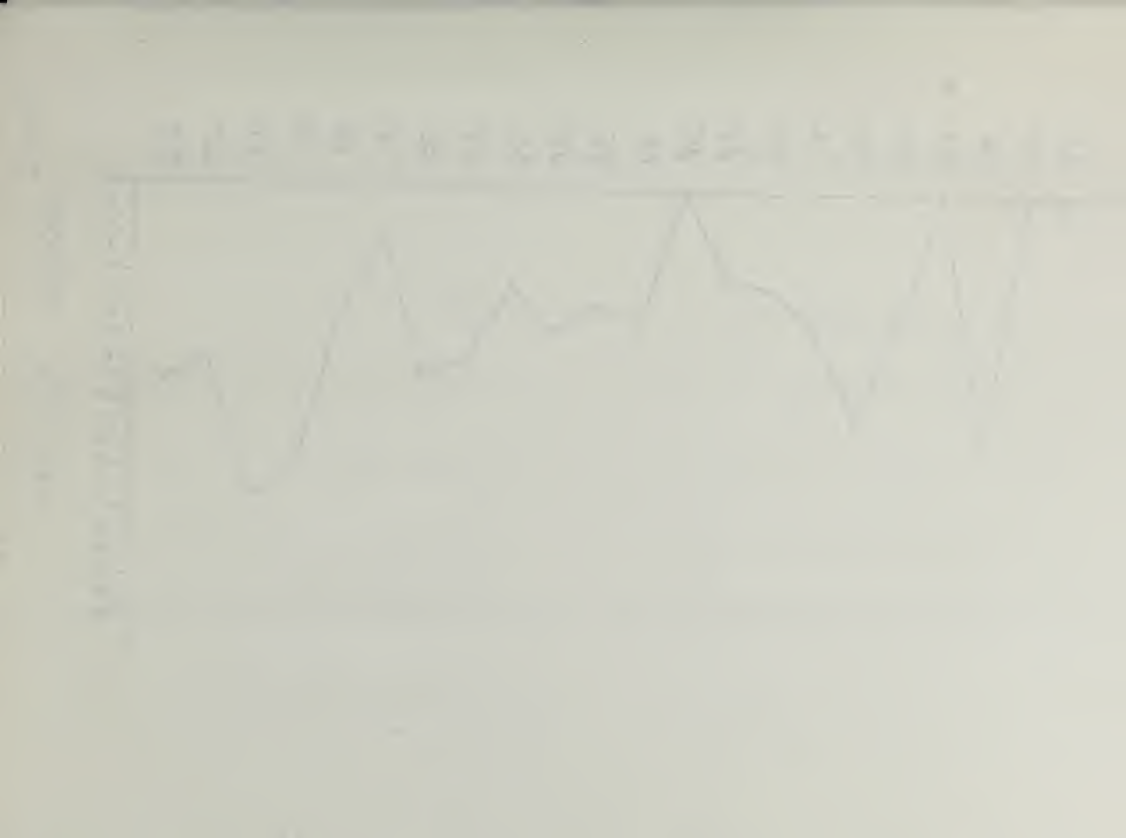
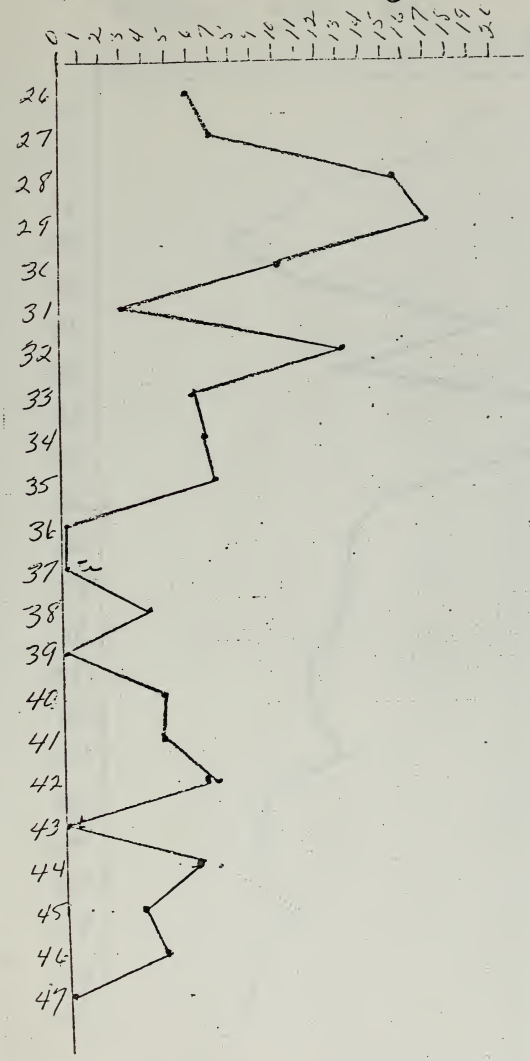
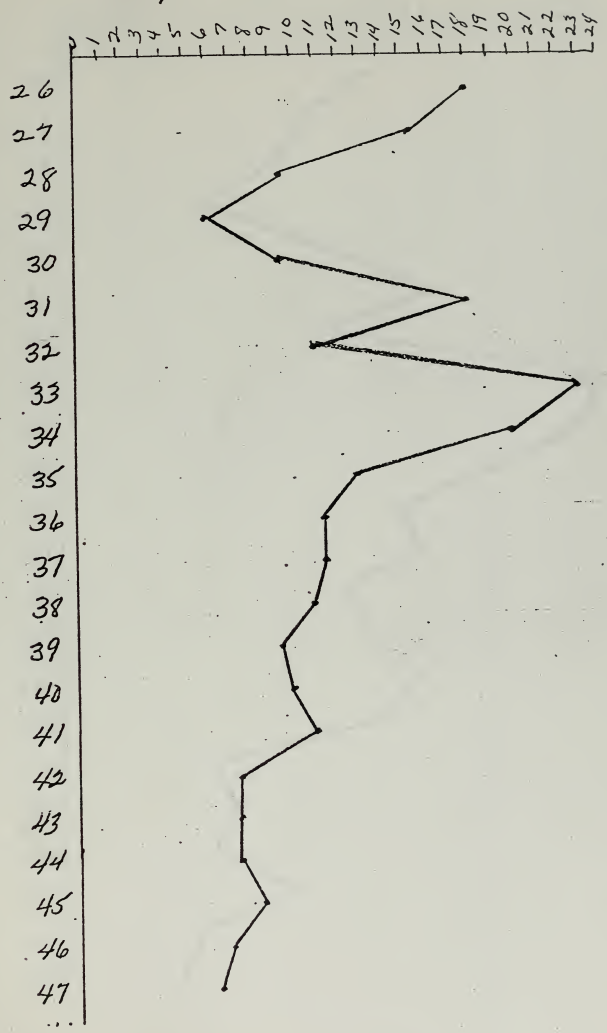
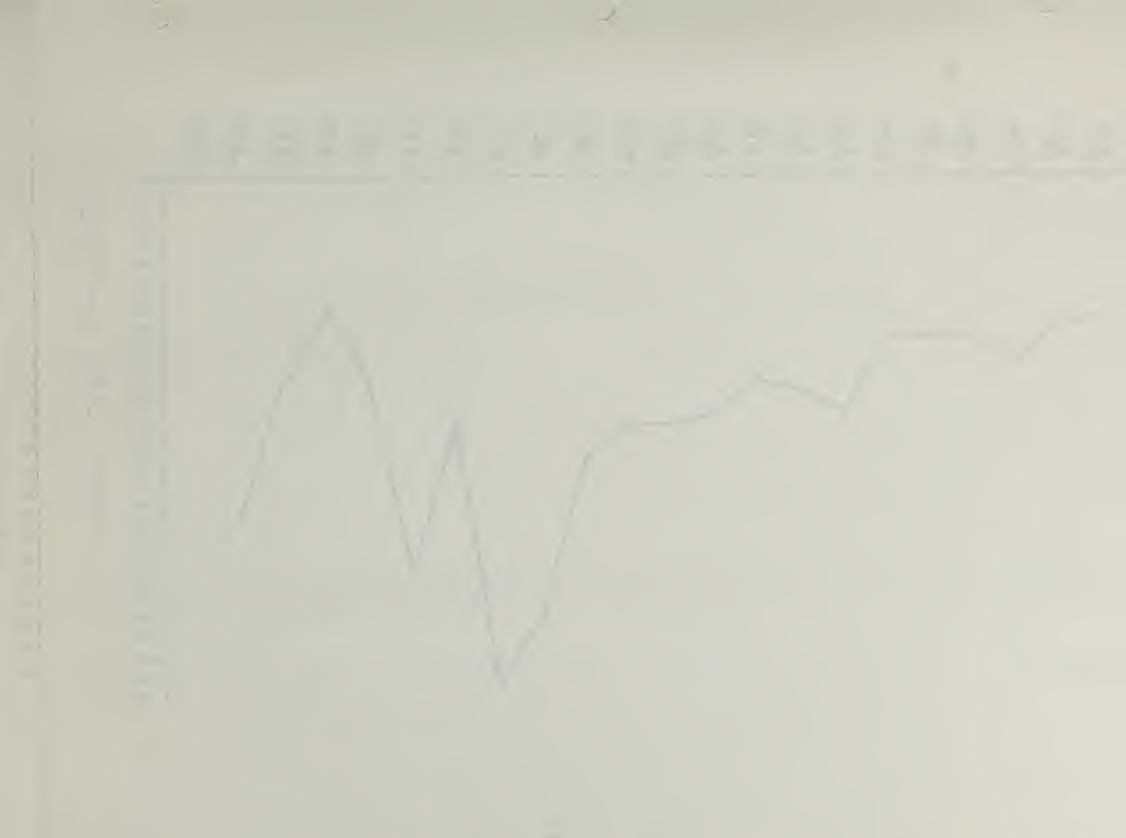


Analcime 265 - 475



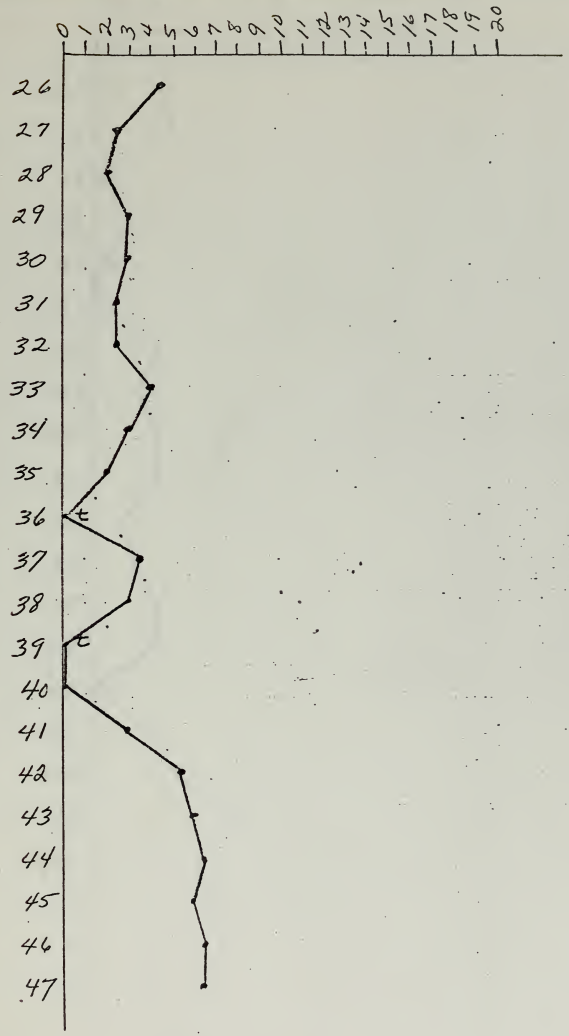
Feldspar 26F - 47F





Feldspar 265–475

I 111 & 26F -47F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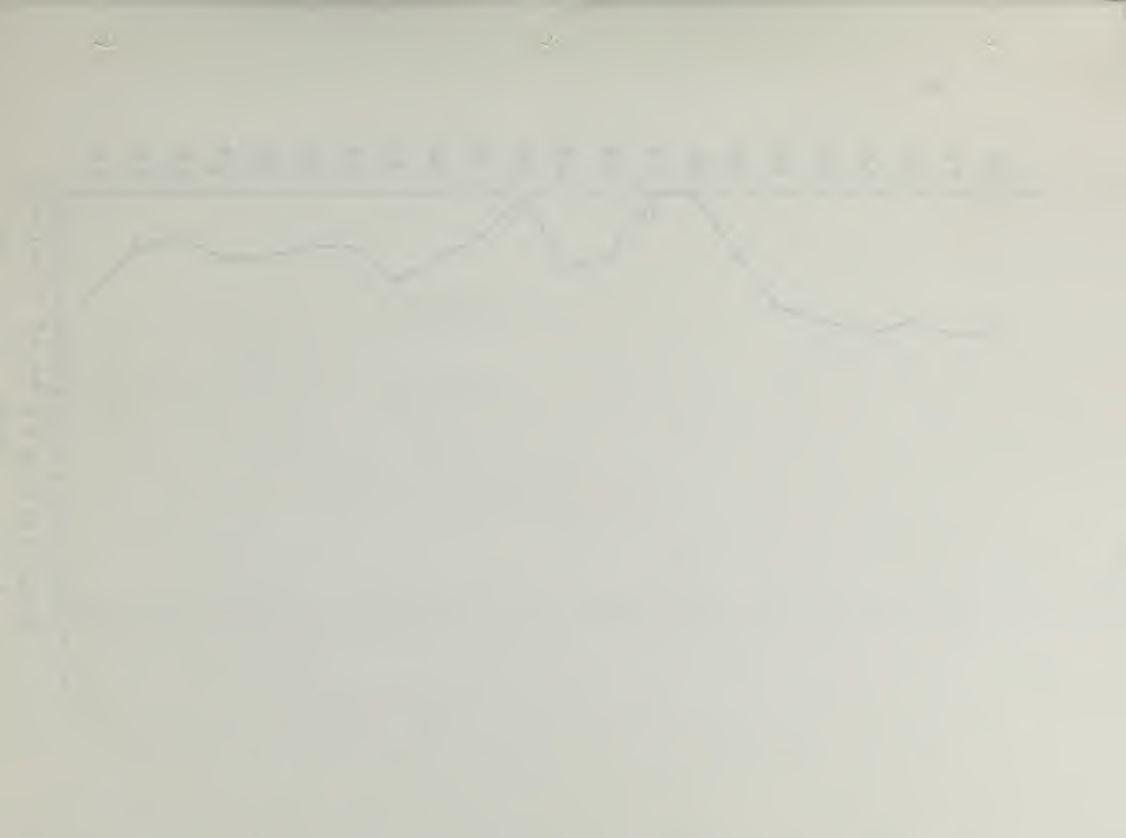
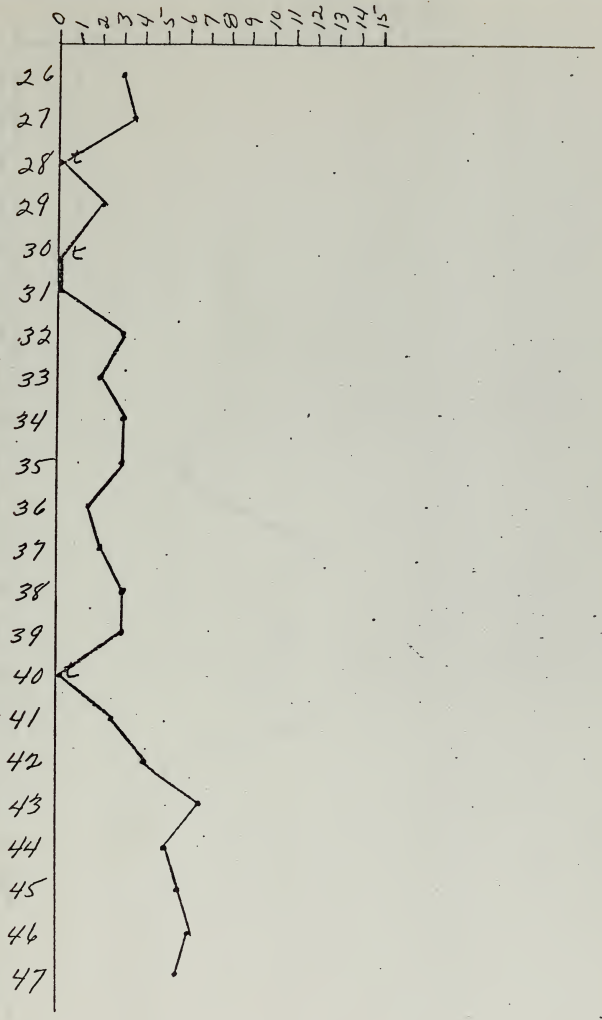


Line 265-475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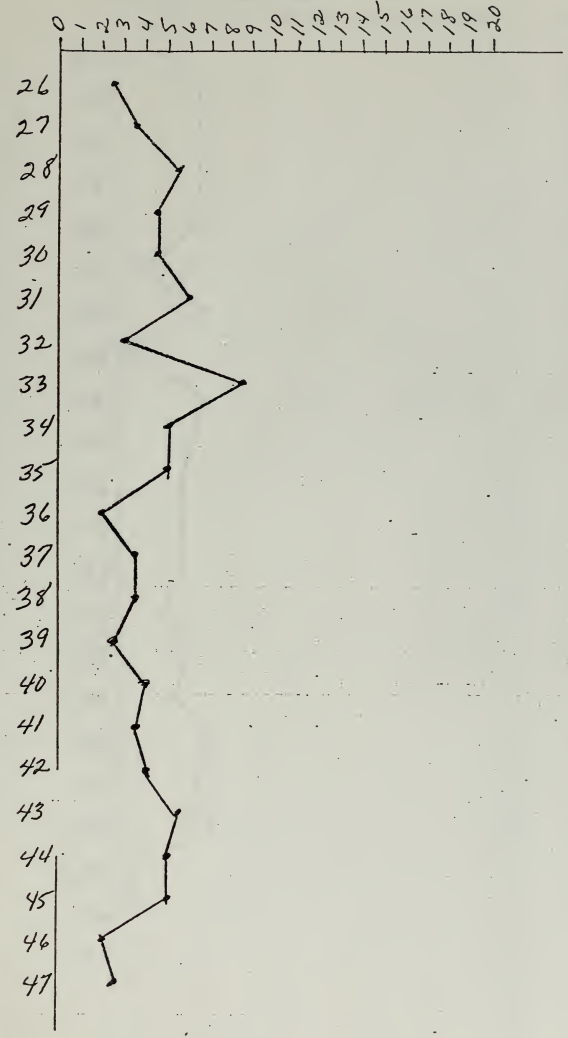
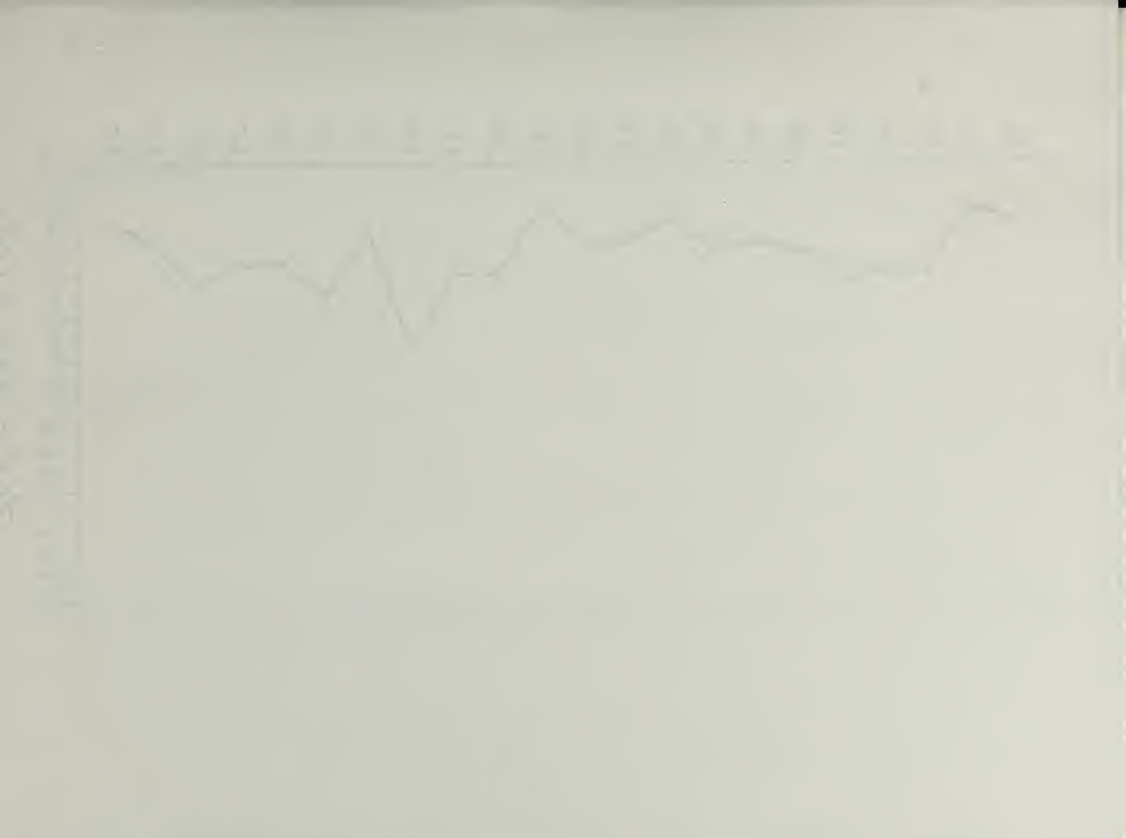
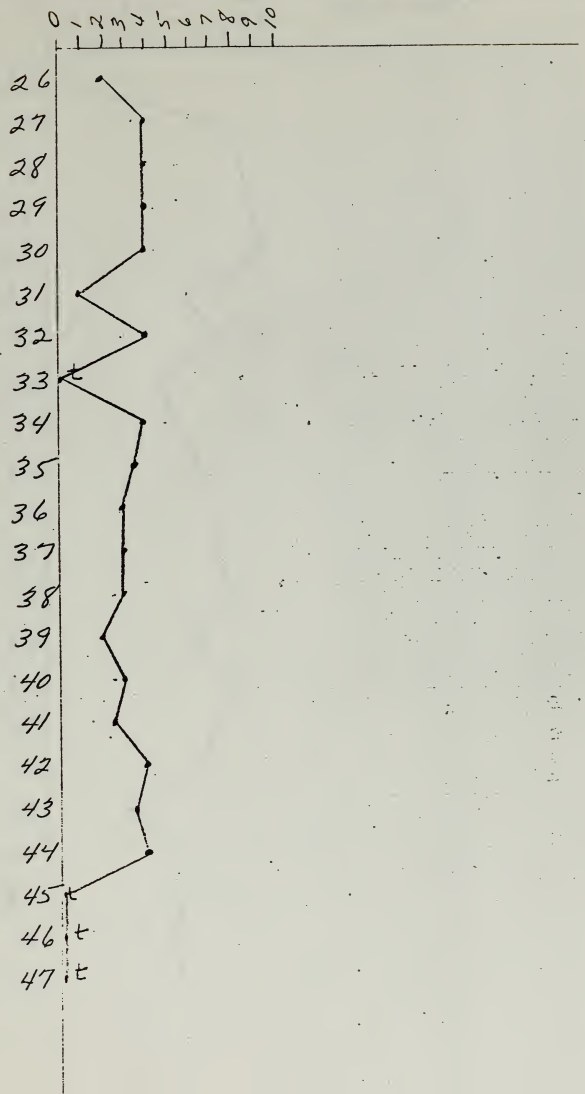
Pyrite 26F–47F





Fym 6 265-475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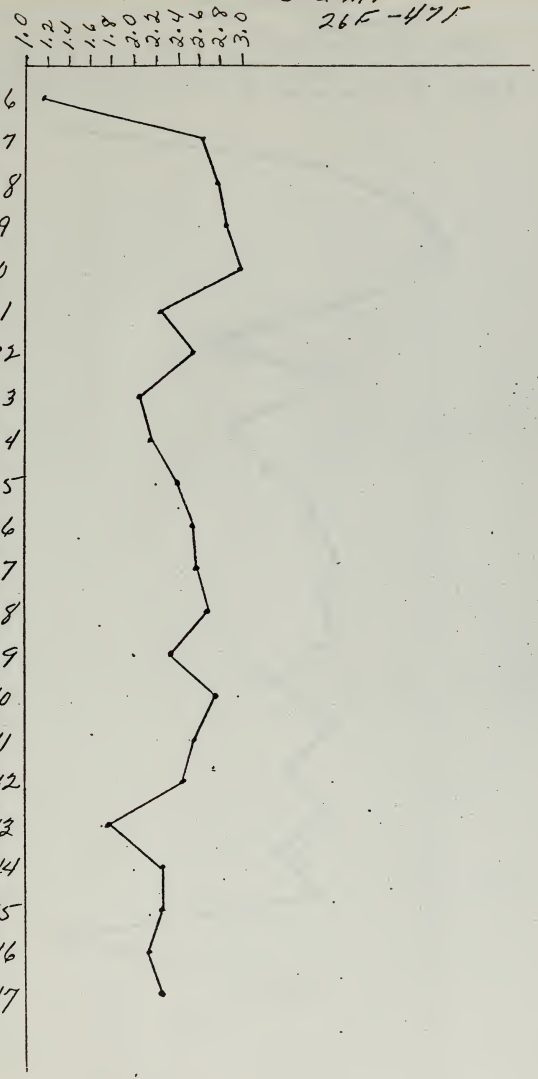
Cadmium
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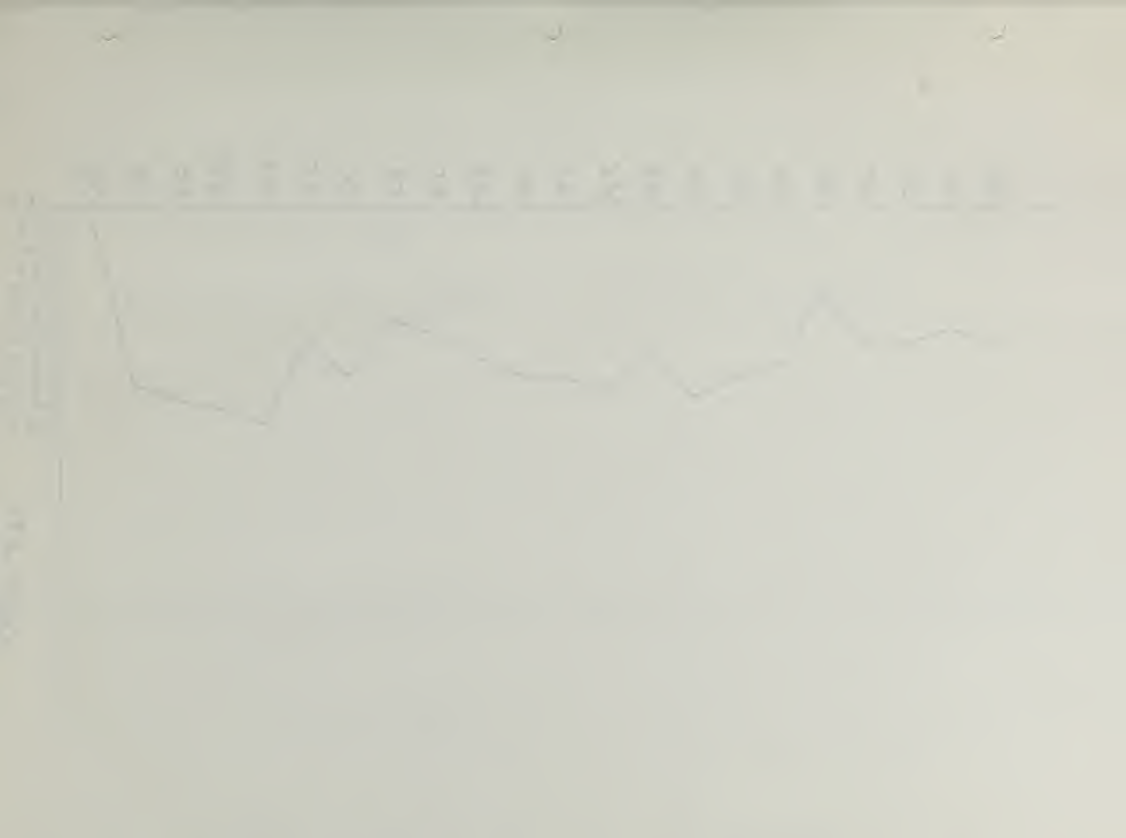

Cadmium
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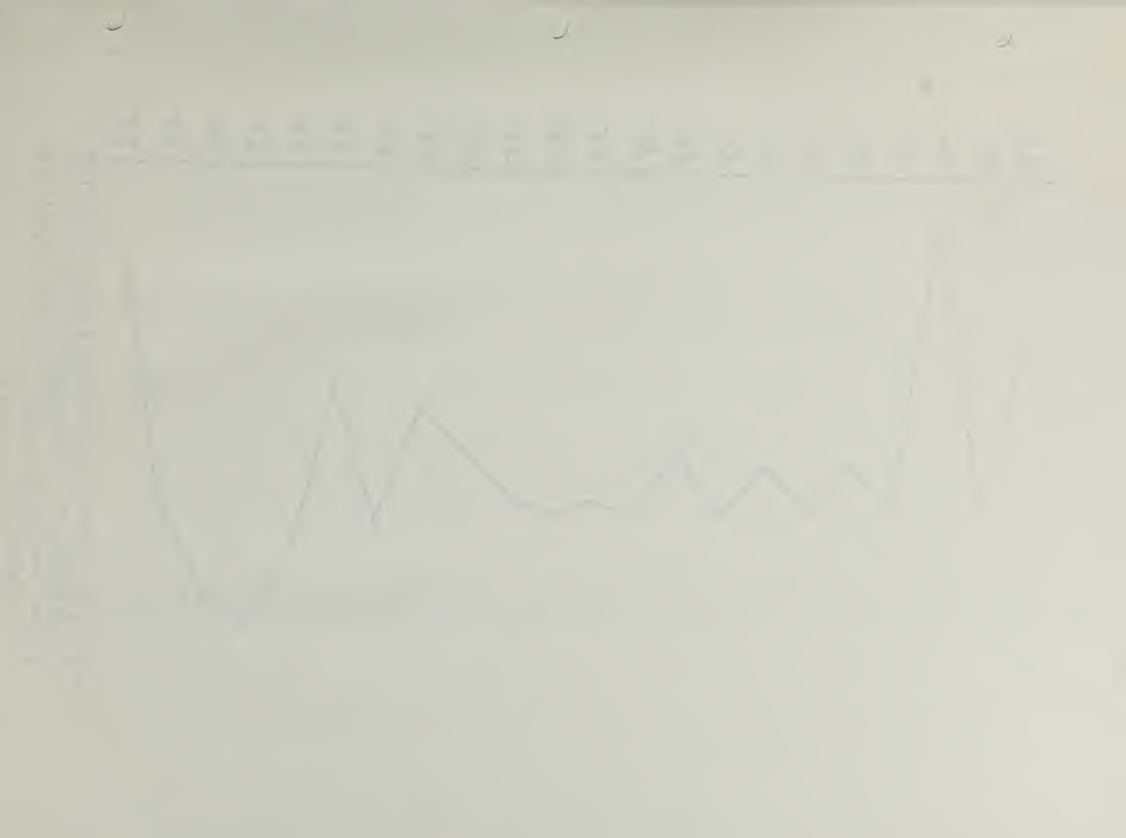
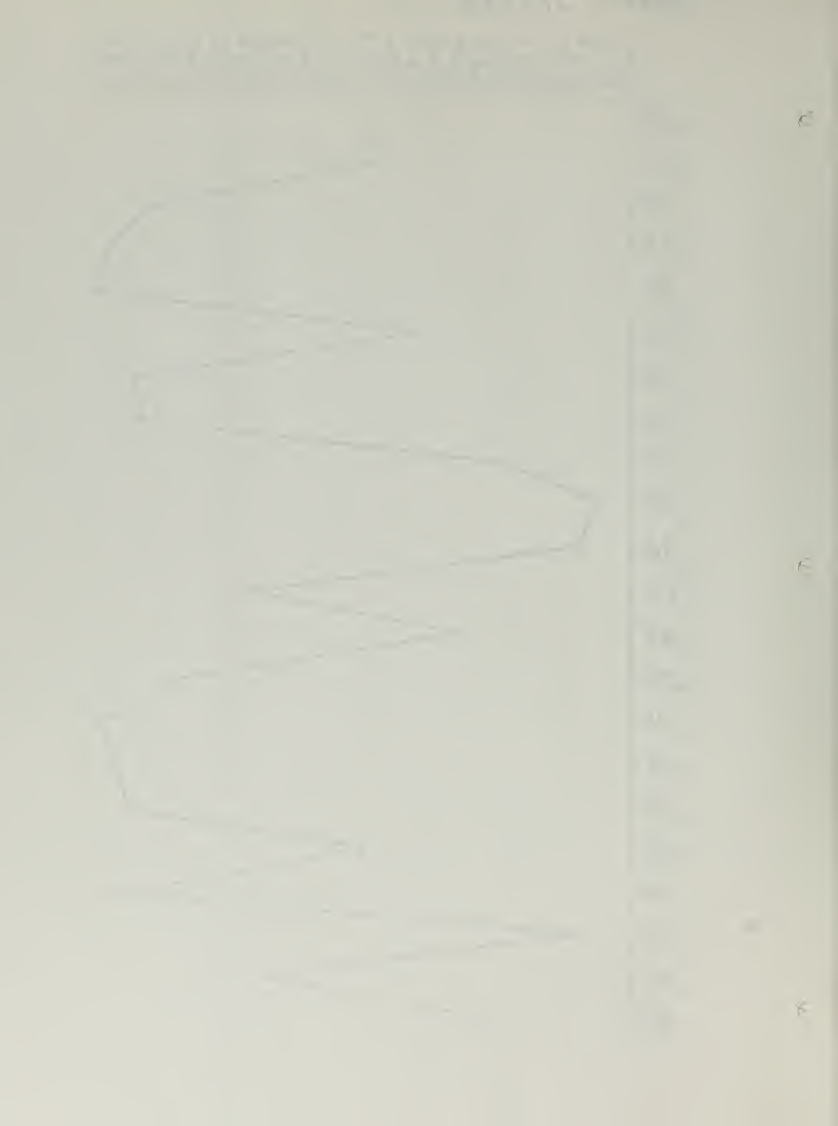
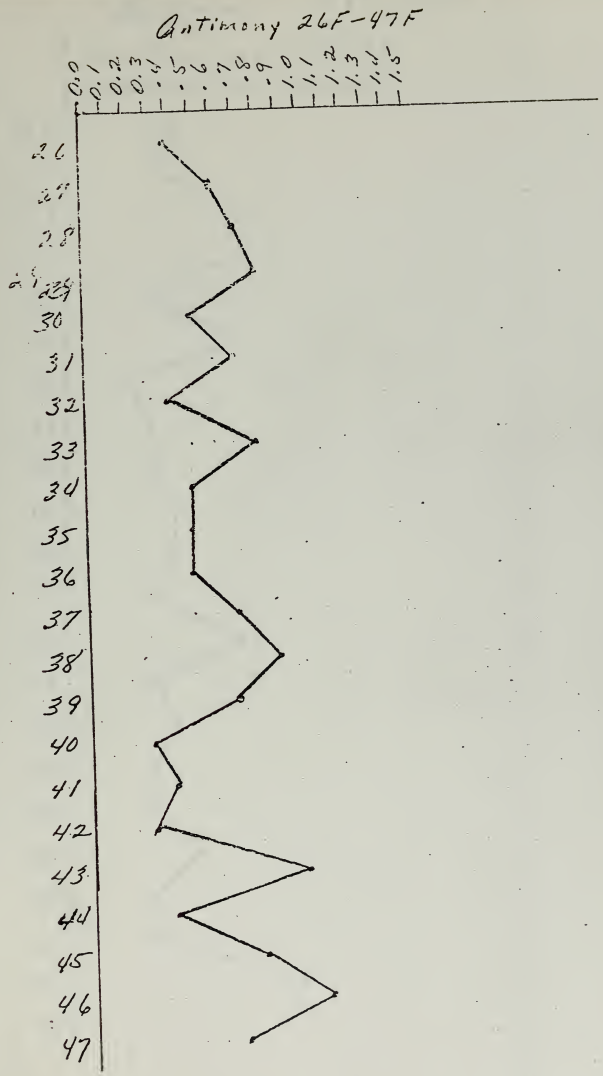


Arsenic 26F-47F

Arsenic 265-475

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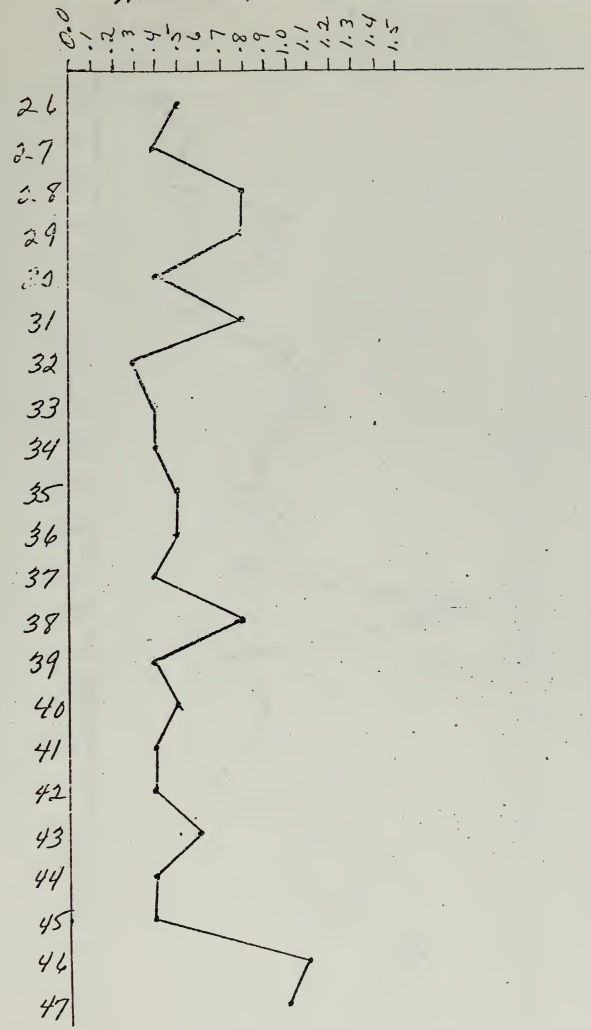
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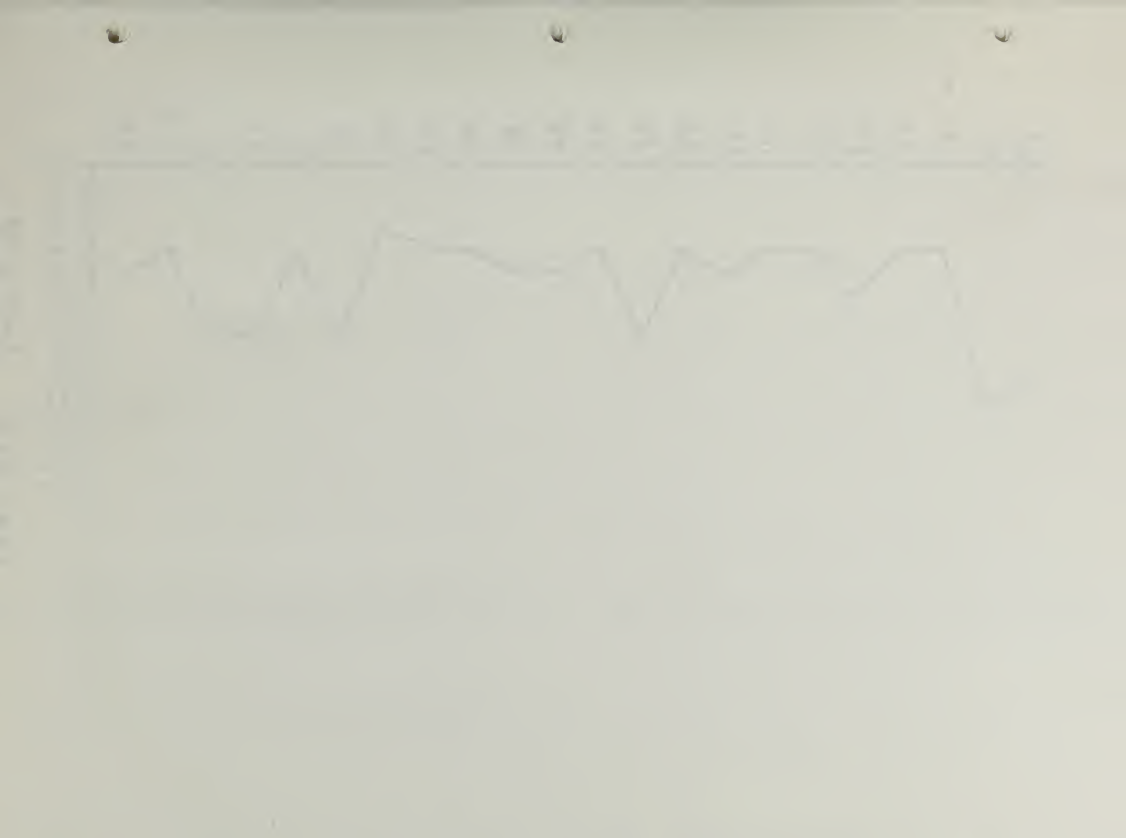
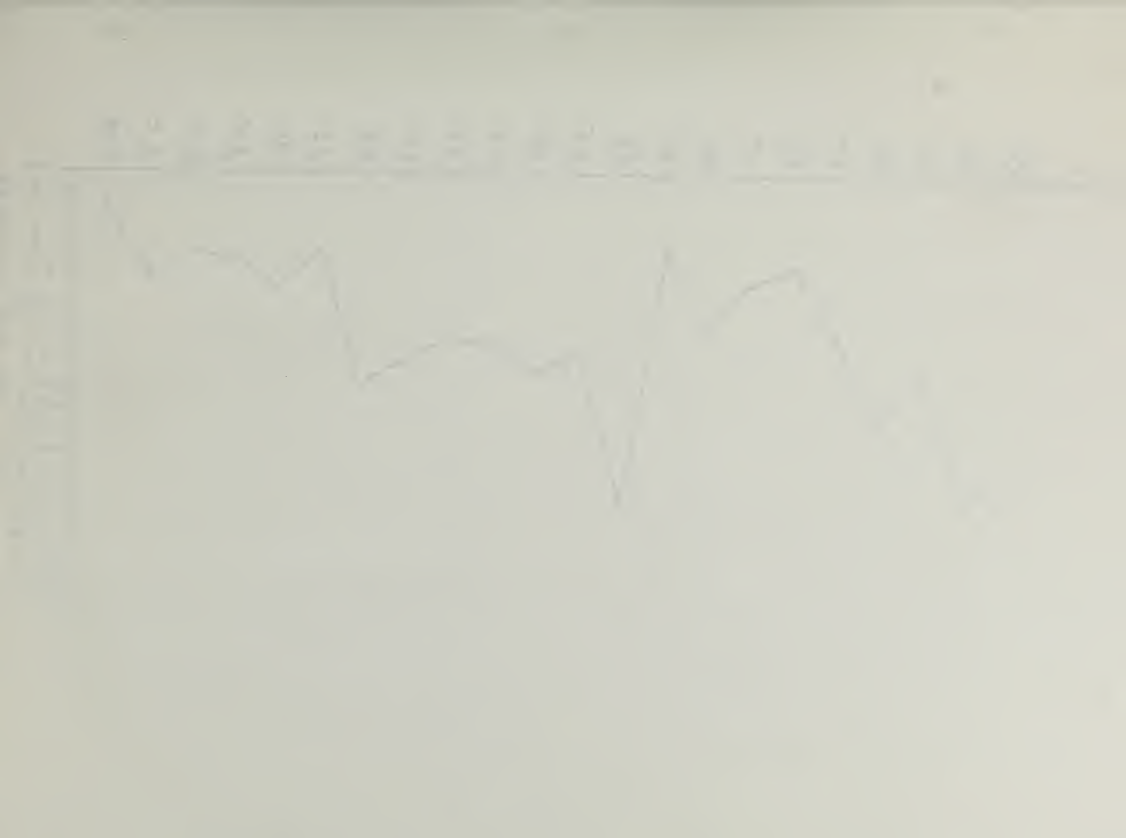
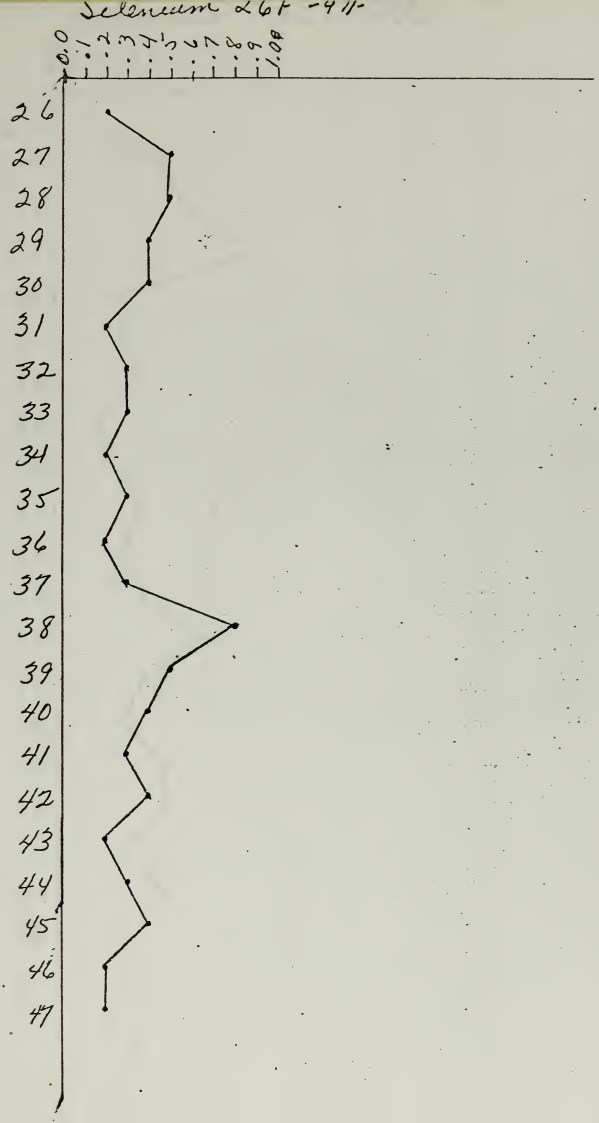


Mercury 26F-47F

Mercury 26 – 47

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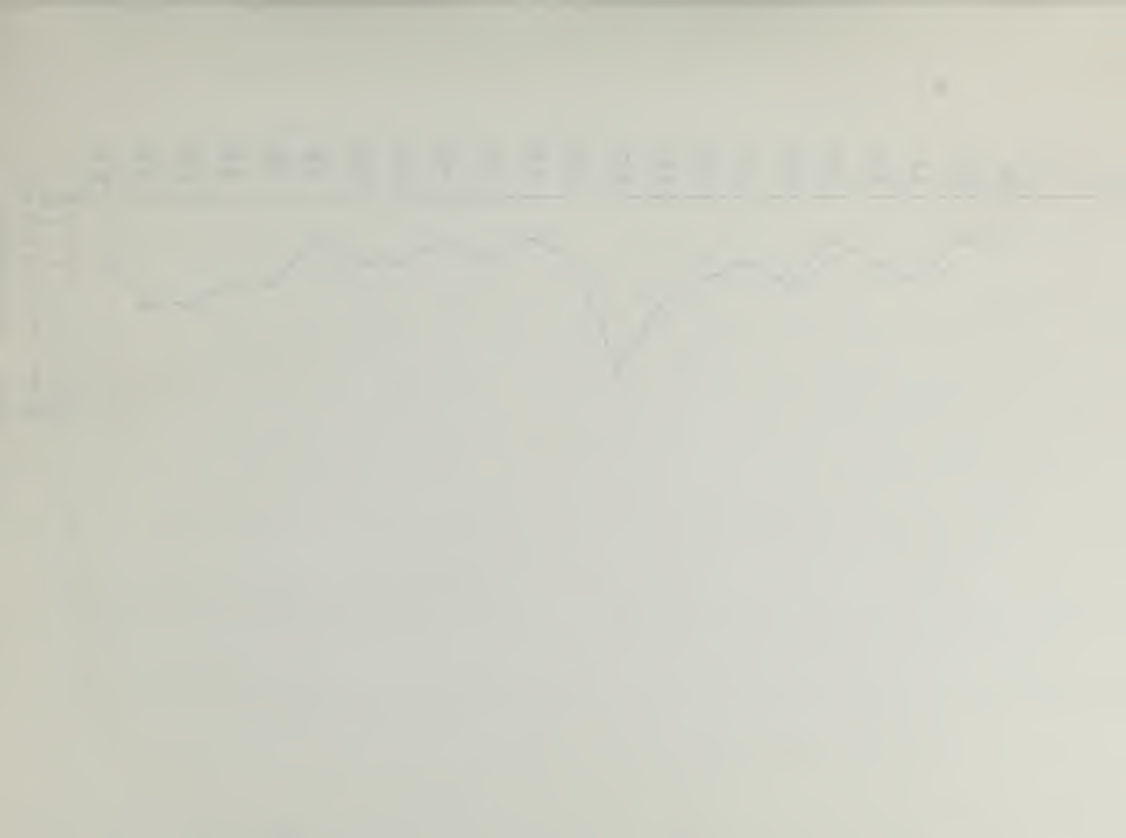

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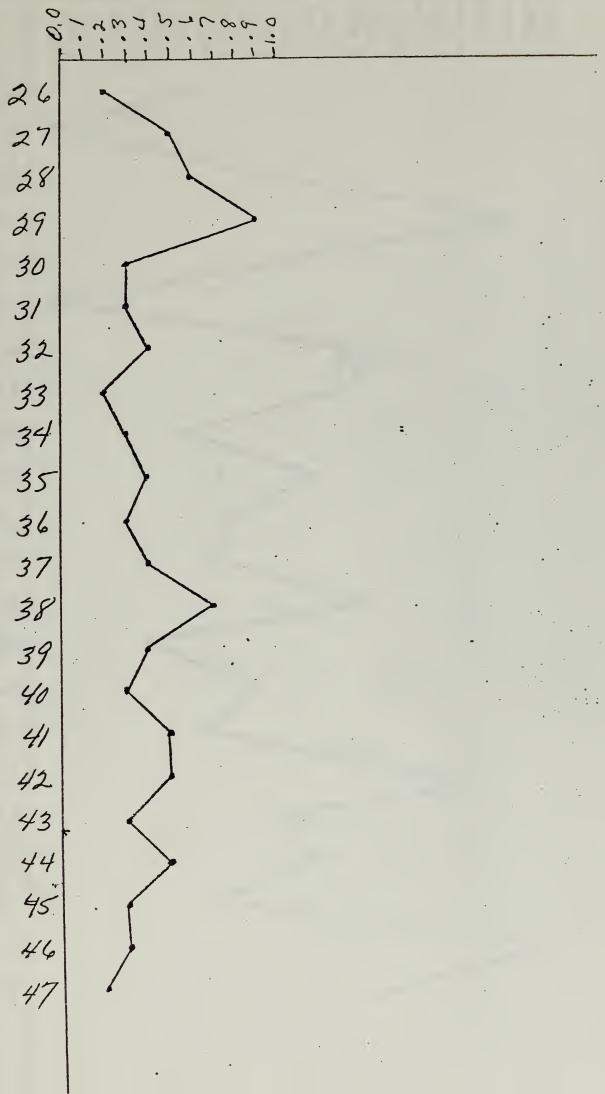

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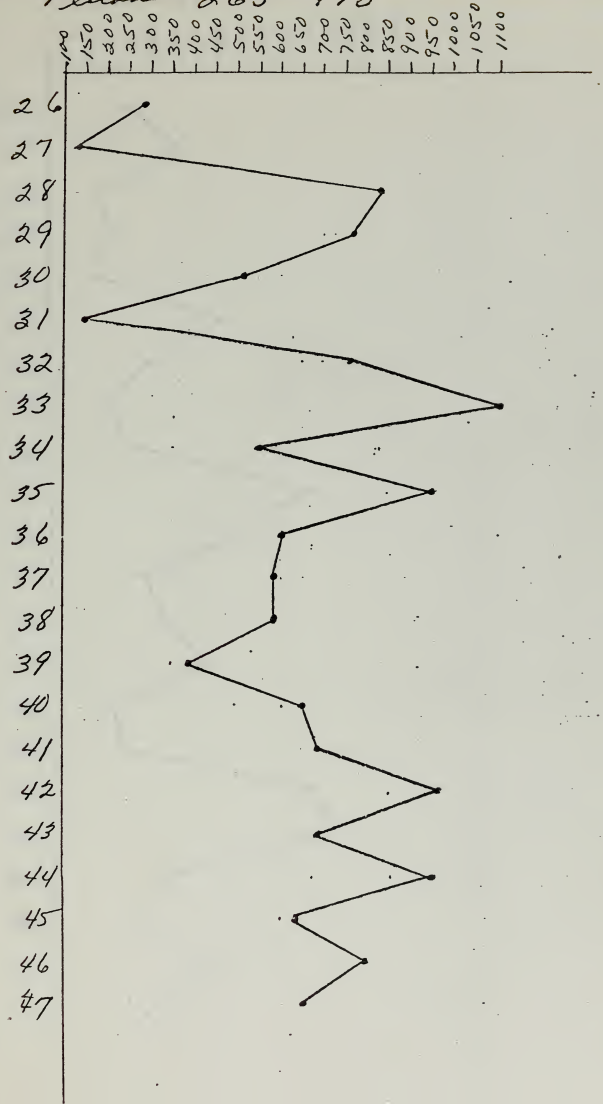
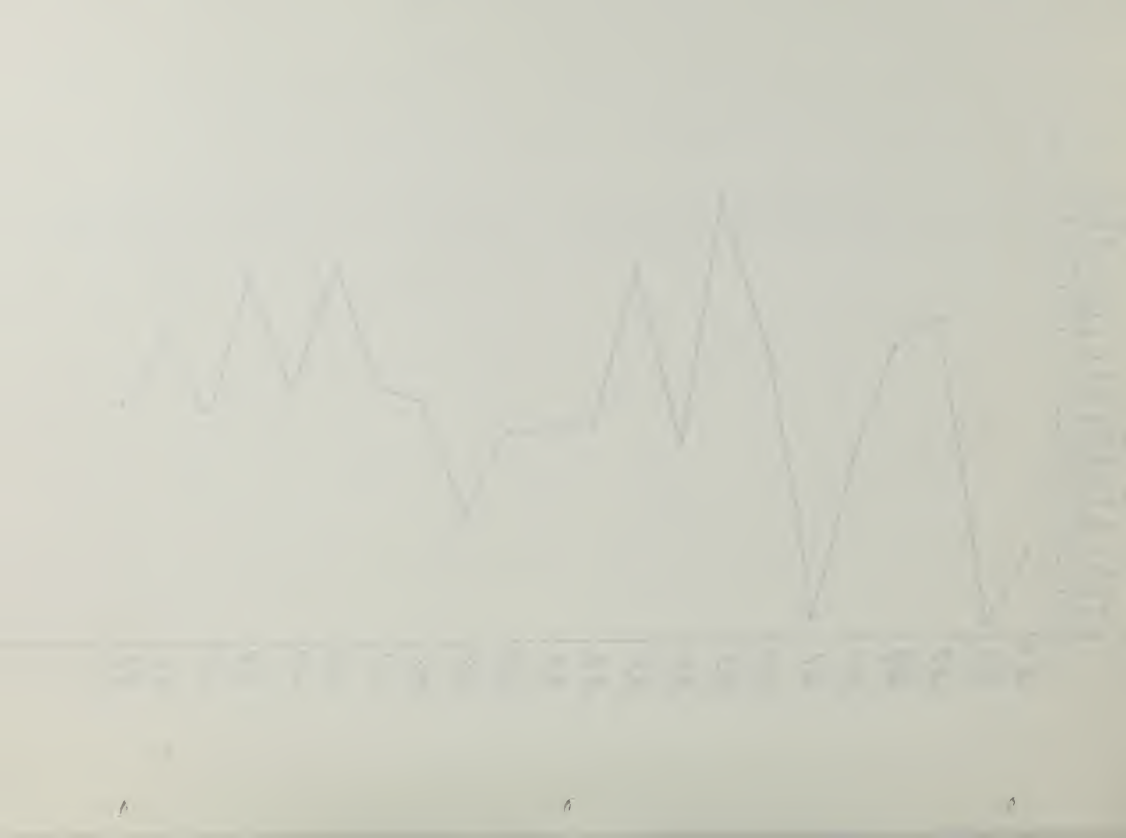
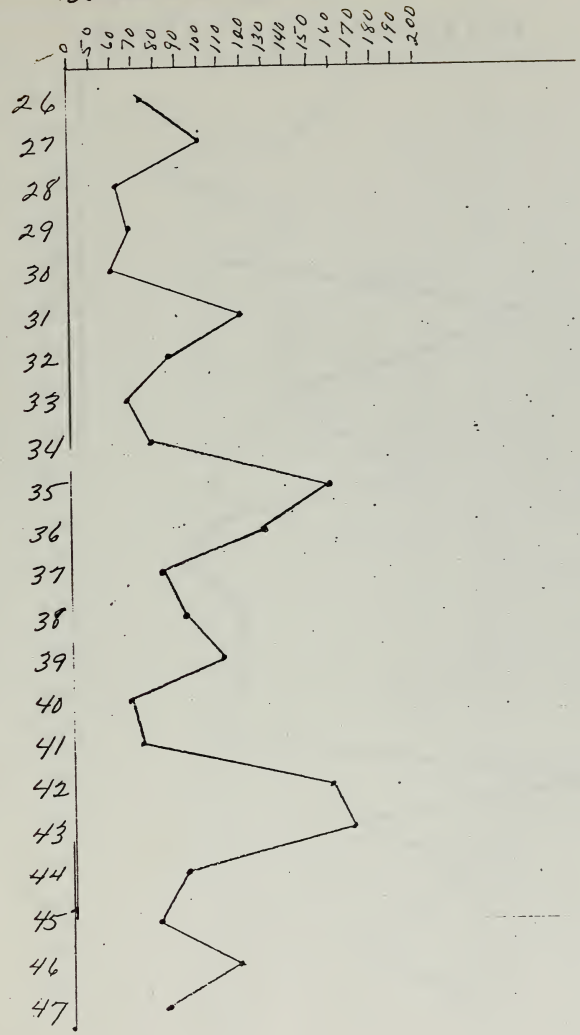
Fluorescence 265 - 475



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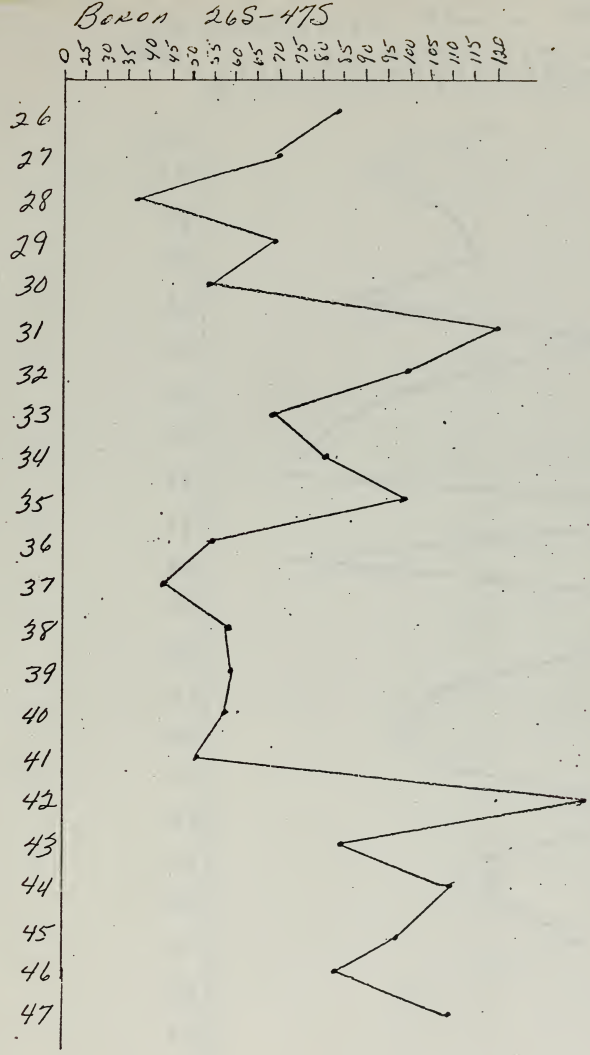
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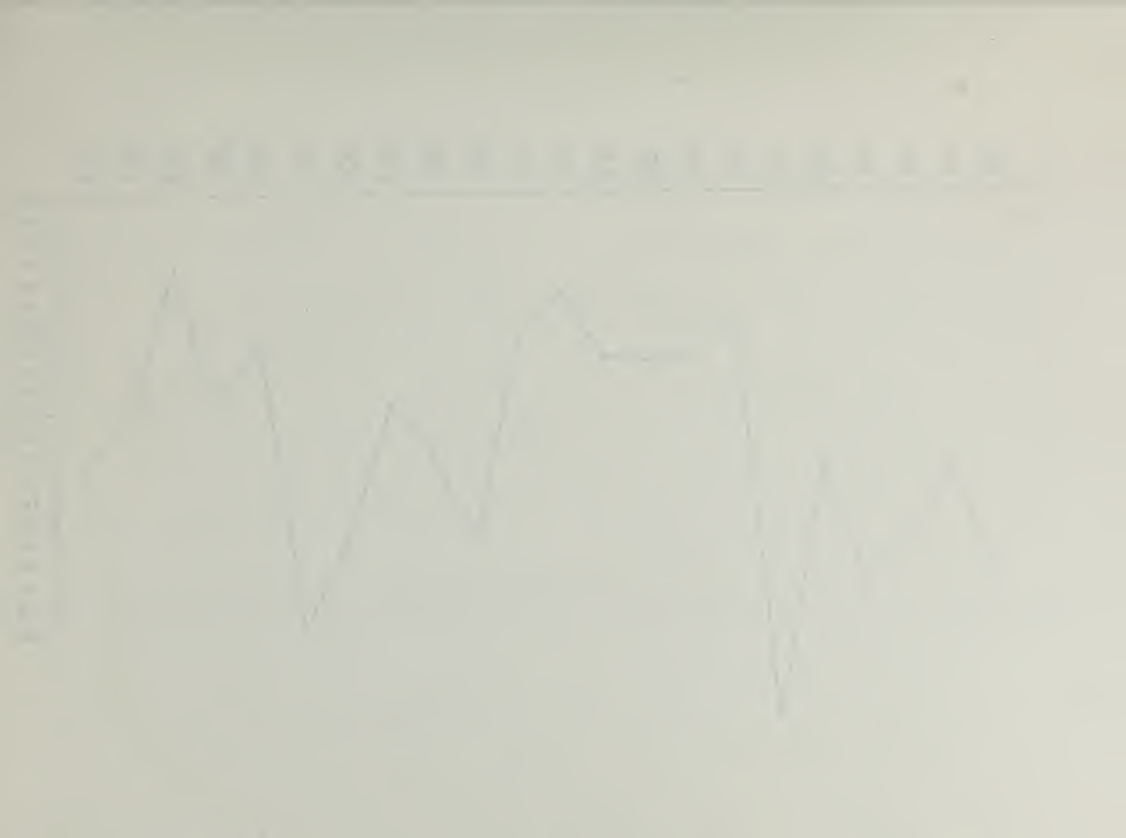
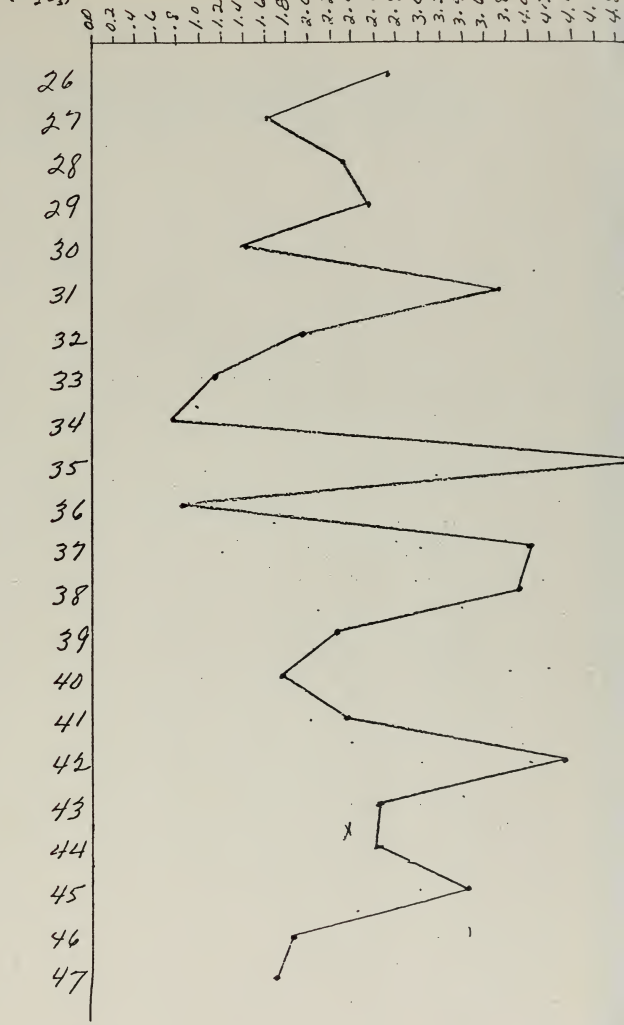


Acid Extractable Alumina 265-475

(Al_2O_3)



1.1.3 Stratigraphic Compilation

The stratigraphic compilation has been completed as reported in RBOSP Progress Report 2. A report by Amuedo and Ivey, Consulting Geologists, describing the basic criteria used in the correlation network is submitted to the Area Oil Shale Supervisor in confidential Section 1.1.3

PROGRESS REPORT 3

GEOTECHNICAL DATA GATHERING PROJECT

GEOLOGIC PROGRAM

SECTION 1.0

CONFIDENTIAL

TO

AREA OIL SHALE SUPERVISOR
UNITED STATES GEOLOGICAL SURVEY

By

RIO BLANCO OIL SHALE PROJECT
Gulf Oil Corporation
and
Standard Oil Company (Indiana)

July 15, 1975

TABLE OF CONTENTS

SECTION NO.

Summary Report Post-Drilling Geologic Studies C-a Tract, by Amuedo and Ivey, Consulting Geologists 1.1.3

STRATIGRAPHIC COMPILATION

SECTION 1.1.3

CONFIDENTIAL

A report by Amuedo and Ivey describing the basic criteria used in construction of the stratigraphic correlation network.

SUMMARY REPORT
POST-DRILLING GEOLOGIC STUDIES
C-A TRACT

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OIL SHALE PROJECT WRITTEN PERMISSION

AMUEDO AND IVEY
CONSULTING GEOLOGISTS
DENVER, COLORADO

AMUEDO AND IVEY
424 DENVER HILTON OFFICE BLDG. • 1515 CLEVELAND PLACE • DENVER, COLORADO 80202
PETROLEUM, MINERAL, ENGINEERING GEOLOGY AND PHOTOGEOLOGY TELEPHONE (303) 534-7187 • CABLE "DAICO"
CURTIS L. AMUEDO
JOHN B. IVEY

April 21, 1975

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Mr. E. A. Ziemba
Rio Blanco Oil Shale Project
Dayton Commons
9725 E. Hampden Avenue
Denver, Colorado 80231

Dear Mr. Ziemba:

This letter transmits six copies of a report, "Summary Report, Post-Drilling Geologic Studies, C-a Tract."

The work described was directly supervised by you and ordinarily a principal in our firm would not be involved in the submission of a report such as this. The usual practice does not apply, however, since the team leader assigned to the project has resigned from our firm. The circumstances surrounding Mr. Hayek's resignation were such that he only submitted a handwritten draft of the report you requested of him.

Since there was some question that this draft would be submitted at all, I requested that Mr. J. G. LaFleur, principal assistant to Mr. Hayek for the project, prepare a report on the procedures used. This was done, and when the Hayek draft was submitted on April 14, 1975 I had Mr. LaFleur combine his draft and that of Mr. Hayek. The report transmitted herewith is the result of this combination.

My principal function in the submission of this report has been to exercise the firm's obligation to prepare the report through those of our staff who were assigned to you. I have reviewed the content of the draft reports, and feel that the final product most closely fulfills our obligations.

Yours very truly,

John B. Ivey

JBI/cw

Summary Report
Post-Drilling Geologic Studies
C-a Tract

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Prepared for

Rio Blanco Oil Shale Project

By

J. G. LaFleur, Amuedo and Ivey
Assistant Team Leader
Under the direction of E. A. Ziemba

April 21, 1975

TABLE OF CONTENTS

	Page No.
Purpose	1
Authorization	1
Project Term	1
Office Location	2
Materials Furnished	2
Sequence of Procedures	3
Explanation of Procedures	4
Selected References	8

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Summary Report
Post-Drilling Geologic Studies
C-a Tract

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Purpose

The purpose of this report is to summarize the procedures followed in completion of work of the post-drilling geologic evaluation of drill-hole and related data obtained on Tract C-a during 1974. This work involved primarily the development of correlations based on core descriptions, density logs, and assays. The designation given by Amuedo and Ivey to this project is SP1-0474-B.

Authorization

The work on phase "B" of SP1-0474 was conducted by a three-man team of Amuedo and Ivey personnel under the direct supervision of E. A. Ziemba of Rio Blanco Oil Shale Project. The Amuedo and Ivey team consisted of Joe LaFleur, Ammon M. Blackford and was headed by Robert Hayek.

Project Term

The project term was anticipated initially to run from Dec. 4, 1974 to Feb. 15, 1975. After work was underway it soon became apparent that the time allotted for the study project would be insufficient and the project study eventually was completed the first week of March, 1975. A final presentation of the cross sections and data sheets was made at a joint meeting of Morrison-Knudsen, Gulf-Standard, and Amuedo and Ivey on Mar. 6, 1975.

Office Location

The AI staff performed their studies and work at AI's Denver Hilton Office Bldg. offices with the exception of the last week which Hayek and Blackford spent at RBOSP offices coordinating the final drafting, proof-reading and compilation of all data accumulated in the study.

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On several occasions, Mr. Ziemba visited the AI offices to inspect the progress of the work and from time to time, Hayek and the AI staff brought their work to RBOSP offices to confer with Mr. Ziemba.

All drafting support was handled by RBOSP in its Dayton Commons offices, with the exception of two final density log cross sections that were drafted by Horst Schlender in AI's office.

Materials Furnished

Rio Blanco furnished AI with the following materials:

A. Fischer oil shale assay results in gallons per ton (gpt, hereafter) for all core holes on tract.

B. Assay data of acid extractable alumina and nahcolite bearing intervals of Gulf-Standard core holes.

C. Dawsonite and nahcolite X-ray diffraction results of Cameron Engineering core holes 702 and 707.

D. Core hole reports for all Cameron Engineering core holes on tract.

E. Mechanical logs for all core holes on tract.

F. Gamma ray/density log cross sections (blueline prints; scale 1"=50').

G. Mylar strips of gamma ray/density logs and assay histograms (scale 1"=50').

H. Assay histogram work sheets (scale 1"=50').

I. Assay histogram cross sections (blueline prints; scale 1"=50').

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Sequence of Procedures

The general sequence of work was as follows:

I. Estimation of yield (gpt) of missing core intervals.

II. Correlation and zonation of gamma ray/density log cross sections.

III. Compilation of stratigraphic correlation depth sheets and recording of depths on cross sections.

IV. Recording acid-extractable aluminum and nahcolite weight percentages on gpt oil histogram cross sections.

V. Plotting base of leaching on gamma ray/density log cross sections.

VI. Recording evidence of faulting on gamma ray/density log cross sections.

VII. Correlation of gpt oil assay histogram cross sections.

VIII. Submission of finalized cross sections and geotechnical data sheets.

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I. Estimates of oil yield, in gpt, were made for those intervals in which the core had been lost in drilling or had been saved for rock mechanics testing. Estimates were based on density log responses. The assay values of the missing core intervals were approximated to the assay results of intervals of similar density response on other logs where assays were available. In those instances where the missing core interval coincided with hole caving, as indicated on the caliper log, the density logs could not be used with certainty. In these instances yield estimates were made by correlating the intervals with the assay histograms of adjacent holes. Missing core assay estimates were drafted onto the assay histogram work sheets and incorporated in the assay data sheets.

All core from GS-13 was held for rock mechanics studies and was not available for plotting of assay data.

II. Development of a stratigraphic correlation network was accomplished by connecting similar density and/or gamma ray responses through the twenty-five coreholes on tract. These correlation lines were drawn on the six gamma ray/density log cross sections provided by RBOSP. The correlation line density was approximately one line per every ten feet of logged hole.

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Zonation was accomplished by emphasizing those correlation lines which separated lean and rich zones. Lean zones were defined by a predominant density log response indicating less than 25 gpt. This figure of 25 gpt was subsequently adjusted, under the direction of E. A. Ziemba, to 17 gpt in correlation of the histogram cross sections.

Zonal designation expanded that already in use (1,2). Rich zones were designated R-0 through R-8 sequentially up-hole. Lean zones were designated L-00 through L-8 sequentially up-hole. Correlation lines within each zone were given alphabetic designations beginning with "a" as the lowest correlation line in that zone. Thus, every correlation line has an unique designation indicating in which zone it is located (e.g. R-5-a). The major lines separating rich and lean zones were given designations which show the zones they separate (e.g. R4/L3).

III. A data sheet for each core hole was prepared giving the following information: 1) correlation line designations, 2) correlation line depths taken directly from the gamma ray/density logs, 3) correlation line depths adjusted to the nearest full assay increment's top or bottom, and 4) assay histogram equivalent correlation

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line depths adjusted to the nearest full assay increment's top or bottom.

The gamma ray/density direct depths and the assay histogram equivalent depths were recorded adjacent to each hole on all of the cross sections.

IV. The following data was plotted in bar-graph form on the assay histogram work sheets: 1) The weight percent of acid extractable alumina for eight Gulf-Standard core holes. 2) The weight percent of nahcolite from known occurrences in the Gulf-Standard core holes. 3) The weight percent of dawsonite and nahcolite as determined by X-ray diffraction for core holes CE 702 and CE 707.

The mode of nahcolite occurrence in all core holes was indicated on the histogram work sheets by means of an alphabetic code.

V. The approximate base of the leached zone, as defined by the lowest occurrence of vugs, was plotted as a heavy, irregular line on the gamma ray/density log cross sections.

VI. Evidence of faulting was plotted on the gamma ray/density log cross sections as being either firm or possible. Firm evidence is defined as fault breccia and/or slickensides. Possible evidence is defined as steep dips, highly broken core (rubble) and/or concentration of slightly offset beds.

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VII. Correlation of the gpt oil assay histogram cross sections was accomplished by connecting similar bar-graph signatures which corresponded most closely to the gamma ray/density log correlation lines. This was done by overlaying the assay histogram mylar strips on the gamma ray/density logs, making slight upward or downward adjustments to fit low-density responses with high assay histogram peaks.

VIII. Finalized working copies of the gamma ray/density log cross sections and the assay histogram cross sections were submitted to RBOSP for final drafting and making of blueline prints.

Finalized, typed copies of correlation data sheets for each core hole were also submitted to RBOSP.

Respectfully submitted,

Joseph G. LaFleur

Joseph G. LaFleur

SELECTED REFERENCES

1. Cashion, W. B., and Donnell, J. R., 1972, Chart showing correlation of selected key units in the organic-rich sequence of the Green River Formation, Piceance Creek Basin, Colorado, and Uinta Basin, Utah: U. S. Geol. Survey Oil and Gas Investigations Chart OC 65.

2. Donnell, J. R., and Blair, R. W., Jr., 1970, Resource appraisal of the three rich oil-shale zones in the Green River Formation, Piceance Creek Basin, Colorado: Colorado School of Mines Quart., v. 65, no. 4, p. 73-87.

1.1.4 Aerial Photography

Aerial photography has been completed as reported in RBOSP Progress Report 2.

1.1.5 Compilation of Topographic Maps

Topographic maps have been revised in that new roads and drill locations were added. Because of the bulky nature of these revisions the maps were transmitted under separate cover to the Area Oil Shale Supervisor but should be considered a part of this progress report.

1.1.6 Photogeologic Mapping

The photogeologic mapping has been completed as reported in RBOSP Progress Report 2.

1.1.7 Surface Geologic Mapping

About ten square miles of surface geologic mapping has been completed as report in RBOSP Progress Report 2.

1.1.8 Seismic Program

The seismic program was discontinued because of its inability to detect a mappable reflection surface. A seismic report by Petroleum Geophysical, Inc. was submitted to the Area Oil Shale Supervisor and should be considered a part of RBOSP Progress Report 2, Section 1.1.8.

1.1.9 Structural Compilation

The structural compilation was reported in RBOSP Progress Report 2. The middle A-groove structure map submitted in Section 1.1.9 of RBOSP Progress Report 2 is a compilation of data from photogeologic, surface geologic, and subsurface corehole control.